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PAGE: 1

RENEWAL DETAILS

PUBLICATION NUMBER GB2395634

PROPRIETOR(S)

Teledyne Technologies Inc, Incorporated in USA - Delaware, 12333
West Olympic Boulevard, Los Angeles, California 90064-1021, United
States of America

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**** END OF REPORT ****

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REGISTER ENTRY FOR GB2395634

Form 1 Application No GB0323990.2 filing date 13.10.2003

Priority claimed:

17.10.2002 in United States of America - doc: 10272753

Title IMPROVEMENTS IN OR RELATING TO AIRCRAFT AVIONICS MAINTENANCE DIAGNOSTICS
DATA DOWNLOAD TRANSMISSION SYSTEM

Applicant/Proprietor

TELEDYNE TECHNOLOGIES INC, Incorporated in USA - Delaware, 12333 West
Olympic Boulevard, Los Angeles, California 90064-1021, United States of
America [ADP No. 08733040001]

Inventors

TAMAS M. IGLOI, 4730 Cadison Street, Torrance, California 90503, United
States of America [ADP No. 08733057001]

GHOBAD KARIMI, 19641 Ansdale Drive, Tarzana, California 91356, United
States of America [ADP No. 08733065001]

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Address for Service

FORRESTER KETLEY & CO, Forrester House, 52 Bounds Green Road, LONDON, N11
2EY, United Kingdom [ADP No. 00000133001]

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Publication of notice in the Patents and Designs Journal (Section 25(1))
26.07.2006

Title of Granted Patent IMPROVEMENTS IN OR RELATING TO AIRCRAFT AVIONICS
MAINTENANCE DIAGNOSTICS DATA DOWNLOAD TRANSMISSION SYSTEM

**** END OF REGISTER ENTRY ****



For Innovation

Teledyne Technologies Inc
c/o Forrester Ketley & Co
Forrester House
52 Bounds Green Road
LONDON
N11 2EY

The Patent Office
Patents Directorate

Concept House
Cardiff Road
Newport
South Wales NP10 8QQ
United Kingdom

Direct line: 08459 500505
Switchboard: 01633 814000
Fax: 01633 814827
Minicom: 08459 222250
DX 722540/41 Cleppa Park 3
<http://www.patent.gov.uk>

Your Reference: P18136GB

27 June 2006

Dear Sir/Madam

PATENTS ACT 1977: PATENTS RULES 1995
NOTIFICATION OF GRANT: PATENT SERIAL NUMBER:GB2395634

1. I am pleased to tell you that your patent application number GB0323990.2 complies with the requirements of the Act and Rules, and that you are therefore granted a patent (for the purposes of Sections 1-23 of the Act) as from the date of this letter.

2. Grant of the patent is expected to be announced in the Patents and Designs Journal on 26 July 2006. In accordance with section 25(1), the patent will be treated for all later sections of the Act as having been granted and as taking effect on that date. The patent specification will be published on the same date, and you will receive the Certificate of Grant for your patent and a copy of the specification shortly afterwards.

3. **IMPORTANT** - It is essential that you take note of the following information about annual renewal payments:

- (i) To keep your patent in force, you must pay the Patent Office an annual renewal fee accompanied by Patents Form 12/77 (which can be obtained from this Office).
- (ii) For most patents, the date on which the first renewal fee is due is determined as follows; calculate the fourth anniversary of the date of filing, and the last day of the month in which this anniversary falls is the date on which the first renewal fee is due. Subsequent renewal fees will be due, each year, on the same due date. If you wish, you can pay a renewal fee in the 3-month period before each due date.

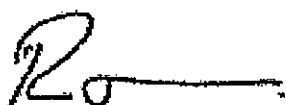
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- (iii) In some cases, though, there are special arrangements for the payment of the first renewal fee on a patent. If those special arrangements apply to your patent, you will be given further information when you receive the Certificate of Grant referred to in paragraph 2.
- (iv) If any renewal fee is not paid by the due date, a further six months is allowed in which to pay the fee. No additional fee is payable if payment is received by the Office during the first month after the due date, but payment received during the second to sixth months after the due date is subject to an additional fee, currently £24 per month or part of a month overdue.
- (v) An example:
For a patent filed on 17 October 2002, the first renewal fee would be due for payment on 31 October 2006. The fee could be paid in advance from 1 August 2006. Subsequent renewal fees would be due on 31 October annually. The first free month of the late payment period would end on 30 November 2006 and if no payment was received by 30 April 2007 the patent would cease.

4. If you would like further information about patent renewal fees, or if you would like us to send you a blank Patents Form 12/77, please telephone our Renewals Section on 01633-814655.

5. Copies of the specification of the granted patent will be placed on sale at the Sales Branch, The Patent Office, Cardiff Road, Newport, South Wales NP10 8QQ as from the date in paragraph 2 above and for a limited period at the London Front Office, Harmsworth House, 13-15 Bouverie, Street, London, EC4Y 8DP. The copies supplied will have the suffix "B" after the serial number to distinguish the specification of the granted patent from that of the published application.

Yours faithfully



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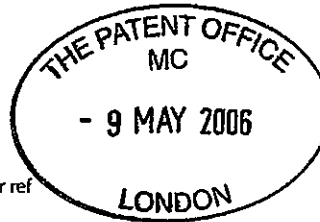
The Patent Office
Cardiff Road
NEWPORT
South Wales
NP10 8QQ

FORRESTER HOUSE
52 BOUNDS GREEN ROAD
LONDON N11 2EY

Telephone +44 (0)20-8889 6622
Fax (Gr 3) +44 (0)20-8881 1088
(Gr 4) +44 (0)20-8889 0131
E-mail fklondon@forresters.co.uk

Our ref
P18136GB - CXL/md

Your ref



Date
08 May 2006

Dear Sirs

B226632/ 001 000389 DOCS.....
10MAY06 0.00 NONE 0323990.2

Re: UK Patent Application No. 0323990.2
Teledyne Technologies Incorporated
Our Ref: P18136GB

We refer to the above-identified application and to the examination report dated 16 February 2006. We request that the time limit for responding to the examination report be extended pursuant to Section 117B. In response to the examination report, we file in duplicate amended pages 7 and 25 to replace the corresponding pages presently on file. A marked-up copy of the amended pages is additionally enclosed.

In response to the objection raised in the examination report, claim 16 has been revised to indicate that the avionics system comprises a plurality of avionics and/or electronic engine control line replaceable units, one or more of which store aircraft maintenance and diagnostic data.

It is therefore submitted that the objection raised by the examiner is now addressed and that the application, as amended, meets the requirements of the Act and Rules and is in order for grant.

Yours faithfully

C. L.
FORRESTER KETLEY & CO

Also at
6TH FLOOR, 105 PICCADILLY, LONDON W1J 7NJ
Tel : +44 (0)20-8889 6622 Fax : +44 (0)20-8889 0131

J D Brown BSc CPA RTMA N H Frankland BSc CPA RTMA
D M Wardley BSc PhD CPhys MInstP CPA RTMA MITMA
R A Lockey BSc PhD AMInstP CPA S J Parry BEng CPA

D J Lucking BSc CPA RTMA MITMA

L D C Hoarton BEng CPA
A T S Beattie MSci CPA

CHAMBERLAIN HOUSE, PARADISE PLACE, BIRMINGHAM B3 3HP
Tel : +44 (0) 121-236 0484 Fax : +44 (0) 121-233 1064
J V Gowshall BSc CPA
S J Wake BSc CPA RTMA MITMA
M N Shaw BSc CPA
S J Leno RTMA MITMA
A C Lawson MA DPhil Oxon CPA

Associates: J C Carstairs BSc CPA
M Tew LLB (Hons) LL.M

G M Dodd BSc CPA
M T Barton BSc PhD MRSC RPA

C Lobban BSc PhD CPA MITMA
S J Forrester MSci RPA

M D Healey BA (Oxon) TMA MITMA

S J Lane BSc LLB RTMA MITMA

Administration Managers: T A Baxter (Birmingham) K Johnson MIPPM(Dip) AIAB fpl (London) Finance Manager: P A Sargent FCCA FMAAT
Consultants: A L Meddle BSc CPA RTMA C Cook RTMA FITMA
Representation at the European Patent Office FORRESTER & BOEHMERT Pettenkoferstrasse 20-22 D-80336 München

IT Manager: G Hughes BSc (Hons) Records: J S Emery
Website: www.forresters.co.uk

The invention further relates to an aircraft maintenance and diagnostic data download system, the aircraft having an avionics system, comprising:

5 means for transmitting aircraft maintenance and diagnostic data from the avionics system via a cellular infrastructure after the aircraft has landed, wherein the transmission of the data is initiated automatically upon landing of the aircraft, and wherein the avionics system comprises a plurality of avionics and/or electronic engine control line replaceable units, wherein one or more avionics and/or electronic
10 engine control line replaceable units stores the aircraft maintenance and diagnostic data; and

means for receiving said data from said cellular infrastructure.

Conveniently said means for transmitting data includes a processor.

15 Preferably said means for receiving data includes a processor.

The invention also relates to a method of downloading maintenance and diagnostic data from an aircraft, comprising:

20 at the aircraft;
receiving the maintenance and diagnostic data from a plurality avionics and/or electronic engine control line replaceable units;

downloading the maintenance and diagnostic data via a cellular communications infrastructure after the aircraft has landed, wherein the cellular
25 communications infrastructure is accessed automatically upon landing of the aircraft; and

at a data reception unit, receiving the downloaded maintenance and diagnostic data, wherein the data reception unit is remotely located from the aircraft.

30 In a further embodiment the invention relates to a method of downloading maintenance and diagnostic data from an avionics system located on an aircraft, comprising:

16. An aircraft maintenance and diagnostic data download system, the aircraft having an avionics system, comprising:

5 means for transmitting aircraft maintenance and diagnostic data from the avionics system via a cellular infrastructure after the aircraft has landed, wherein the transmission of the data is initiated automatically upon landing of the aircraft, and wherein the avionics system comprises a plurality of avionics and/or electronic engine control line replaceable units, wherein one or more avionics and/or electronic
10 engine control line replaceable units stores the aircraft maintenance and diagnostic data; and

means for receiving said data from said cellular infrastructure.

17. An aircraft maintenance and diagnostic data download system of Claim 16,
15 wherein said means for transmitting data includes a processor.

18. An aircraft maintenance and diagnostic data download system of Claim 16 or 17, wherein said means for receiving data includes a processor.

20 19. A method of downloading maintenance and diagnostic data from an aircraft, comprising:

at the aircraft;

receiving the maintenance and diagnostic data from a plurality of avionics and/or electronic engine control line replaceable units;

25 downloading the maintenance and diagnostic data via a cellular communications infrastructure after the aircraft has landed, wherein the cellular communications infrastructure is accessed automatically upon landing of the aircraft; and

at a data reception unit, receiving the downloaded maintenance and
30 diagnostic data, wherein the data reception unit is remotely located from the aircraft.

The invention further relates to an aircraft maintenance and diagnostic data download system, the aircraft having an avionics system, comprising:

5 | means for transmitting aircraft maintenance and diagnostic data from the avionics system via a cellular infrastructure after the aircraft has landed, wherein the transmission of the data is initiated automatically upon landing of the aircraft, and wherein the avionics system comprises a plurality of avionics and/or electronic engine control line replaceable units, wherein one or more avionics and/or electronic
10 | engine control line replaceable units stores the aircraft maintenance and diagnostic data; and

means for receiving said data from said cellular infrastructure.

Conveniently said means for transmitting data includes a processor.

15

Preferably said means for receiving data includes a processor.

The invention also relates to a method of downloading maintenance and diagnostic data from an aircraft, comprising:

20 | at the aircraft;
receiving the maintenance and diagnostic data from a plurality avionics and/or electronic engine control line replaceable units;
downloading the maintenance and diagnostic data via a cellular communications infrastructure after the aircraft has landed, wherein the cellular
25 | communications infrastructure is accessed automatically upon landing of the aircraft; and

at a data reception unit, receiving the downloaded maintenance and diagnostic data, wherein the data reception unit is remotely located from the aircraft.

30 | In a further embodiment the invention relates to a method of downloading maintenance and diagnostic data from an avionics system located on an aircraft, comprising:

16. An aircraft maintenance and diagnostic data download system, the aircraft having an avionics system, comprising:

5 means for transmitting aircraft maintenance and diagnostic data from the avionics system via a cellular infrastructure after the aircraft has landed, wherein the transmission of the data is initiated automatically upon landing of the aircraft, and wherein the avionics system comprises a plurality of avionics and/or electronic engine control line replaceable units, wherein one or more avionics and/or electronic
 10 engine control line replaceable units stores the aircraft maintenance and diagnostic data; and

means for receiving said data from said cellular infrastructure.

17. An aircraft maintenance and diagnostic data download system of Claim 16,
 15 wherein said means for transmitting data includes a processor.

18. An aircraft maintenance and diagnostic data download system of Claim 16 or 17, wherein said means for receiving data includes a processor.

20 19. A method of downloading maintenance and diagnostic data from an aircraft, comprising:

at the aircraft;

receiving the maintenance and diagnostic data from a plurality of avionics and/or electronic engine control line replaceable units;

25 downloading the maintenance and diagnostic data via a cellular communications infrastructure after the aircraft has landed, wherein the cellular communications infrastructure is accessed automatically upon landing of the aircraft; and

at a data reception unit, receiving the downloaded maintenance and
 30 diagnostic data, wherein the data reception unit is remotely located from the aircraft.



Teledyne Technologies Inc
c/o Forrester Ketley & Co
Forrester House
52 Bounds Green Road
LONDON
N11 2EY

**The Patent Office
Patents Directorate**

Concept House
Cardiff Road, Newport
South Wales, NP10 8QQ

Examiner: 01633 813684
E-Mail: nigel.hall@patent.gov.uk
Switchboard: 01633 814000
Fax: 01633 814444
Minicom: 08459 222250
DX: 722540/41 Cleppa Park 3
<http://www.patent.gov.uk>

Your Reference: P18136GB-NF/jsd
Application No: GB0323990.2

16 February 2006

Dear Sirs

Patents Act 1977: Examination Report under Section 18(3)

Latest date for reply: 18 April 2006

I have re-examined your application in response to your agent's letter of 15 February 2006 and enclose two copies of my further examination report.

By the above date you should either file amendments to meet the objections in the enclosed report or make observations on them. If you do not, the application may be refused.

Yours faithfully

Mr Nigel Hall
Examiner



Your ref : P18136GB-NF/jsd
Application No: GB0323990.2
Applicant : Teledyne Technologies Inc
Latest date for reply: 18 April 2006

Examiner : Mr Nigel Hall
Tel : 01633 813684
Date of report : 16 February 2006
Page 1/1

Patents Act 1977

Examination Report under Section 18(3)

Basis of the examination

1. My examination has taken account of the amendments filed with your agent's letter of 14th January 2006.

Inventive step

1. The argument for the inventiveness of the independent claims set out in your agent's letter of 14th January 2006 is based on the fact that a plurality of avionics and/or electronic engine control line replaceable units transmit maintenance and diagnostic data from internal equipment to an on-board cellular communications unit, in distinction to the case in the cited document where data acquisition units transmit parametric flight data. Since claim 16 makes no mention of these avionics and/or electronic engine control line replaceable units, the inventive step objection of the official letter of 16th November 2005 still stands against this claim.

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NEWPORT
South Wales
NP10 8QQ

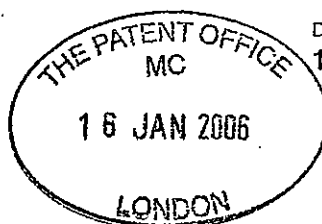
FORRESTER HOUSE
52 BOUNDS GREEN ROAD
LONDON N11 2EY

Telephone +44 (0)20-8889 6622
Fax (Gr 3) +44 (0)20-8881 1088
(Gr 4) +44 (0)20-8889 0131
E-mail fklondon@forresters.co.uk

Our ref
P18136GB - NHF/ns

Your ref

Date
14 January 2006



Dear Sirs

Re: UK Patent Application No. 0323990.2
Teledyne Technologies Incorporated
Our Ref: P18136GB

In connection with this Application and with reference to the outstanding Examination Report we now file amended pages 3-9, 11 and 11B and also fresh pages of Claims to be substituted for the corresponding pages as at present on file.

The Examination Report maintains an inventive step rejection with respect to US Patent No. 6181990.

The Applicants' invention is directed to an aircraft maintenance and diagnostic data download system. The aircraft maintenance and diagnostic data download system comprises an aircraft that has an avionics system and a communication unit. The avionics system comprises a plurality of avionics and/or electronic engine control line replaceable units, and one or more of the avionics and/or electronic engine control line replaceable units store aircraft maintenance and diagnostic data. The communications unit is connected to one or more avionics and/or electronic engine control line replaceable units.

The avionics system also comprises a cellular infrastructure that is in communication with the communications unit after the aircraft has landed. The communications unit is used for downloading the aircraft maintenance and diagnostic data, and the communication is initiated automatically upon the landing of the aircraft.

Further, the avionics system comprises a data reception unit that is connected to the cellular infrastructure. The data reception unit is remotely located from the aircraft, and the data reception unit receives the aircraft maintenance and diagnostic data from the communications unit.

Also at
6TH FLOOR, 105 PICCADILLY, LONDON W1J 7NJ
Tel: +44 (0)20-8889 6622 Fax: +44 (0)20-8889 0131

CHAMBERLAIN HOUSE, PARADISE PLACE, BIRMINGHAM B3 3HP
Tel: +44 (0) 121-236 0484 Fax: +44 (0) 121-233 1064

J D Brown BSc CPA RTMA N H Frankland BSc CPA RTMA D J Lucking BSc CPA RTMA MITMA J V Gowshall BSc CPA S J Wake BSc CPA RTMA MITMA
D M Wardley BSc PhD CPhys MInstP CPA RTMA MITMA L D C Hoarton BEng CPA K Richardson MA Contab CPA M N Shaw BSc CPA S J Leno RTMA MITMA
R A Lockey BSc PhD AMinstP CPA S J Parry BEng CPA A T S Beatlie MSc CPA
Associates: J C Carstairs BSc CPA C Lobban BSc PhD CPA R T Walker MSc CPA M T Barton BSc PhD MRSC RPA S J Forrester MSc RPA G M Dodd BSc CPA
A C Lawson MA DPhil Oxon CPA

Records: J S Emery Finance Manager: P A Sargent FCCA FMAAT
Consultants: A I Meddle BSc CPA RTMA C Cook RTMA FITMA
Representation at the European Patent Office FORRESTER & BOEHMERT Pettenkoferstrasse 20-22 D-80336 München

VAT Registration No. GB-110 0242 58

Website: www.forresters.co.uk

Exhibit Q - Part 1
Page 74

The Applicants' invention is also directed to a method of downloading maintenance and diagnostic data from an aircraft. At the aircraft, maintenance and diagnostic data is received from a plurality avionics and/or electronic engine control line replaceable units. The maintenance and diagnostic data is then downloaded via a cellular communications infrastructure after the aircraft has landed. The cellular communications infrastructure is accessed automatically upon landing of the aircraft. The downloaded maintenance and diagnostic data is received at a data reception unit. The data reception unit is remotely located from the aircraft.

US Patent No. 6,181,990 (the '990 patent) discloses an aircraft data transmission system. The aircraft data transmission system is used to transfer parametric flight data to a flight operations center. Examples of parametric data include air speed, altitude, vertical acceleration, heading and time parameters. The aircraft data transmission system has a data acquisition unit. It also includes a communications unit located in the aircraft and in communication with the data acquisition unit. The system further includes a cellular infrastructure in communication with the data communications unit after the aircraft has landed, and a data reception unit in communication with the cellular infrastructure. Once the cellular connections are made, data can flow bidirectionally from or to the aircraft.

The Examination Report cited the '990 patent against Claims 1 through 36. The Applicants respectfully assert that independent Claims 1, 12, 17-18, 21-22, 28, 32 and 36-40. are patentable over the '990 patent. More specifically, the Applicants respectfully submit that the Claims as now amended are not anticipated nor rendered obvious by the cited reference.

The, '990 patent discloses a data transmission system that has a data acquisition unit. The data transmission system transmits parametric flight data, such as air speed, altitude, vertical acceleration, heading and time parameters to a flight operations center via a cellular infrastructure.

Unlike the Applicants' invention, the '990 lacks a description of an avionics system that comprises a plurality of avionics and/or electronic engine control line replaceable units. These avionics and/or electronic engine control line replaceable units are different from data acquisition units. The avionics and electronic engine control line replaceable units obtain maintenance and diagnostic data from internal equipment (other than data acquisition units) that resides on-board airplanes. Such internal equipment may include an Electronic Engine Computer (EEC), Data Encryption Unit (DEU), Flight Management Computer (FMC), etc. The maintenance and diagnostic data received from the internal equipment (other than data acquisition units) is then downloaded. Contrastingly, in the '990 patent, the data acquisition unit is limited to acquiring parametric data. The '990 patent lacks any mention of or reference to acquiring maintenance and diagnostic data from internal equipment (other than data acquisition units). Moreover, in the '990 patent, the parametric data -- not maintenance and diagnostic data -- is transmitted.

Clearly, the '990 patent does not teach, suggest or disclose receiving maintenance and diagnostic data from a plurality of avionics and/or electronic engine control line

replaceable units and downloading such data as described in the Claims as now amended.

In light of the difference discussed above, the Applicants submit that the independent Claims now on file, and hence all the Claims dependent thereon, recite novel physical and functional features that patently distinguish over any and all references. Moreover the dependent Claims recite additional novel structures, functions, and steps that are even more remote from the teachings of the cited references.

We trust that the Application will now be found to be in order for grant.

Yours faithfully

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Thus, there is a need for an aircraft maintenance/diagnostics download system that automatically transfers aircraft/engine and maintenance/diagnostic data to the airline's or operator's maintenance and engineering centre with little or no human involvement, and which relies on a widely available and reliable public wireless, public switch telephone network (PSTN), integrated services digital network (ISDN), and/or Internet delivery systems.

10 The present invention, which addresses this need, resides in a system, method and an article of manufacture for transmitting maintenance and diagnostic data from an aircraft.

According to one aspect of this invention there is provided an aircraft maintenance and diagnostic data download system, comprising:

an aircraft having an avionics system and a communication unit, wherein the avionics system comprises a plurality of avionics and/or electronic engine control line replaceable units, wherein one or more avionics and/or electronic engine control line replaceable unit stores aircraft maintenance and diagnostic data, and wherein the communications unit is connected to one or more avionics and/or electronic engine control line replaceable units;

a cellular infrastructure in communication with said communications unit after the aircraft has landed, wherein the communications unit is used for downloading the aircraft maintenance and diagnostic data, and wherein the communication is initiated automatically upon the landing of the aircraft; and

a data reception unit, connected to the cellular infrastructure, wherein the data reception unit is remotely located from the aircraft, and wherein the data reception unit receives the aircraft maintenance and diagnostic data from the communications unit.

Advantageously said data reception unit is in communication with said
5 cellular infrastructure via a computer network.

Preferably the computer network is the Internet.

Conveniently said data reception unit is in communication with said
10 cellular infrastructure via a telephone network.

Preferably the telephone network is a public switch telephone network.

Advantageously the telephone network is an integrated services digital
15 telephone network.

Preferably said communications unit includes:

an avionics input/output interface;

a processor that is connected to the avionics input/output interface;

20 a multi-port serial card in communication with said processor;

a plurality of cell channels in communication with said multi-port serial
card; and

one or more antennas in communication with said cell channels.

5

Conveniently said cellular infrastructure includes:

- an antenna;
- 5 a transceiver subsystem in communication with said antenna; and
- a controller in communication with said transceiver subsystem.

Advantageously said data reception unit includes:

- a router; and
- 10 a processor in communication with said router, said processor having a storage unit.

According to another aspect of this invention there is provided an aircraft maintenance and diagnostic data download system, comprising:

- 15 an avionics system that comprises a plurality of avionics and/or electronic engine control line replaceable units, wherein one or more avionics and/or electronic engine control line replaceable unit stores aircraft maintenance and diagnostic data;

- an avionics input/output interface that is connected each of the avionics
- 20 and/or electronic engine control line replaceable units;

a processor that is connected to the avionics input/output interface;

a multi-port serial card that is connected to the processor; and

- a plurality of cell channels connected to the multi port serial card, said cell channels for downloading aircraft maintenance and diagnostic data to a
- 25 data reception unit via a cellular infrastructure after the aircraft has landed, wherein the data reception unit is remotely located from the aircraft, and wherein the communication between the cell channels and the multi port serial card is automatically initiated upon the landing of the aircraft.

30

6

The system may further comprise one or more antennas in communication with said cell channels.

5

Advantageously the processor is a personal computer.

Alternatively the processor is an application specific integrated circuit.

10

Alternatively the processor is a microprocessor.

The invention also relates to an aircraft, comprising:

an avionics system having a plurality of avionics and/or electronic engine control line replaceable units, wherein one or more avionics and/or electronic engine control line replaceable unit stores aircraft maintenance and diagnostic data; and

15 a communication unit, wherein the communications unit is used for downloading the aircraft maintenance and diagnostic data, and the communication unit is connected to one or more of the avionics and/or electronic engine control line replaceable units, and wherein the communication unit comprises:

an avionics input/output interface;

a processor connected to the avionics input/output interface;

a multi-port serial card connected to the processor; and

25 a plurality of cell channels connected to the multi port serial card, said cell channels for downloading aircraft maintenance and diagnostic data to a data reception unit that is remotely located from the aircraft via a cellular infrastructure after the aircraft has landed, wherein the communication between the cell channels and the multi port serial card is automatically initiated upon the landing of the aircraft.

30

7

The invention further relates to an aircraft maintenance and diagnostic data download system, the aircraft having an avionics system, comprising:

- means for transmitting data from the avionics system via a cellular
- 5 infrastructure after the aircraft has landed, wherein the transmission of the data is initiated automatically upon landing of the aircraft; and
- means for receiving said data from said cellular infrastructure.

Conveniently said means for transmitting data includes a processor.

10

Preferably said means for receiving data includes a processor.

The invention also relates to a method of downloading maintenance and diagnostic data from an aircraft, comprising:

- 15 at the aircraft;
- receiving the maintenance and diagnostic data from a plurality avionics and/or electronic engine control line replaceable units;
- downloading the maintenance and diagnostic data via a cellular communications infrastructure after the aircraft has landed, wherein the cellular
- 20 communications infrastructure is accessed automatically upon landing of the aircraft; and
- at a data reception unit, receiving the downloaded maintenance and diagnostic data, wherein the data reception unit is remotely located from the aircraft.

25

In a further embodiment the invention relates to a method of downloading maintenance and diagnostic data from an avionics system located on an aircraft, comprising:

8

receiving the maintenance and diagnostic data from a plurality of avionics and/or electronic engine control line replaceable units;

5 processing maintenance and diagnostic data; and
downloading the processed maintenance and diagnostic data to a data reception unit that is remotely located from the aircraft via a cellular infrastructure after the aircraft has landed, wherein the cellular infrastructure is accessed automatically upon landing of the aircraft.

10

The method may further comprise receiving said transmitted data at a flight operations centre.

15 Alternatively the method may further comprise receiving said transmitted data at a flight operations centre via a computer network.

Alternatively the method may further comprise receiving said transmitted data at a flight operations centre via a telephone network.

20 Preferably processing said data includes:
compressing the data;
encrypting the data;
segmenting the data; and
constructing packets of data from said segmented data.

25

Conveniently receiving said transmitted data includes:
acknowledging receipt of said transmitted data;
reassembling said received data;

9

decrypting said reassembled data;
 uncompressing said decrypted data; and
 storing said uncompressed data.

5

The invention may be considered to relate to a method of downloading maintenance and diagnostic data from an aircraft, comprising:

receiving maintenance and diagnostic data from a plurality of avionics and/or electronic engine control line replaceable units;

10 processing the maintenance and diagnostic data; and

downloading the processed maintenance and diagnostic data to a data reception unit that is remotely located from the aircraft via a cellular infrastructure after the aircraft has landed, wherein processing said data includes;

15 receiving a signal which indicates that the data downloading process can begin;

initiating a data transfer;

compressing said data;

encrypting said compressed data;

20 creating a packet queue;

starting a primary data thread;

waiting a predetermined period of time;

determining if any threads are active;

repeating, when threads are active, the steps of waiting a predetermined
 25 period of time and determining if any threads are active; and

exiting processing said data when no threads are active.

Advantageously repeating steps a through h includes repeating steps a through h in parallel for each said secondary data thread.

- 5 The invention also relates to a computer-implemented method of downloading maintenance and diagnostic data from an aircraft, comprising:
- receiving the maintenance and diagnostic data from a plurality of avionics and/or electronic engine control line replaceable units;
 - processing the maintenance and diagnostic data; and
 - 10 downloading the processed data via a cellular infrastructure after the aircraft has landed; and
 - ~~receiving the downloaded maintenance and diagnostic data at a flight~~ operations centre, wherein receiving said downloaded maintenance and diagnostic data includes;
 - 15 creating a socket;
 - receiving a message;
 - determining if said message is an initialisation message;
 - initiating a session when said message is an initialisation message;
 - determining if said message is a data message when said message is not
 - 20 an initialisation message;
 - processing said message when said message is a data message;
 - determining if said message is an end session when said message is not a data message;
 - processing said message when said message is a data message;
 - 25 determining if said message is an end session when said message is not a data message;
 - processing said message when said message is an end session; and
 - repeating, when said message is not an end session message, the step of receiving a message.

11B

receiving maintenance and diagnostic data from a plurality of avionics
5 and/or electronic engine control line replaceable units;

processing said maintenance and diagnostic data to prepare said data for
downloading; and

10 downloading said processed maintenance and diagnostic data to a data
reception unit that is remotely located from the aircraft via a cellular
~~infrastructure when said aircraft has landed, wherein the cellular infrastructure~~
is accessed automatically upon landing of the aircraft.

15 The system comprises an aircraft, a cellular infrastructures and a data
reception unit. The aircraft has an avionics system and a communications unit.
The avionics system comprises a plurality of line replaceable units. The
communications unit is connected to each line replaceable unit. The cellular
infrastructure is in communication with said communications unit after the
20 aircraft has landed. The communication is initiated automatically upon the
landing of the aircraft. The data reception unit is connected to the cellular
infrastructure.

CLAIMS:

5

1. An aircraft maintenance and diagnostic data download system, comprising:

an aircraft having an avionics system and a communication unit, wherein the avionics system comprises a plurality of avionics and/or electronic engine control line replaceable units, wherein one or more avionics and/or electronic engine control line replaceable unit stores aircraft maintenance and diagnostic data, and wherein the communication unit is connected to one or more avionics and/or electronic engine control line replaceable units;

a cellular infrastructure in communication with said communications unit after the aircraft has landed, wherein the communications unit is used for downloading the aircraft maintenance and diagnostic data, and wherein the communication is initiated automatically upon the landing of the aircraft; and

a data reception unit, connected to the cellular infrastructure, wherein the data reception unit is remotely located from the aircraft, and wherein the data reception unit receives the aircraft maintenance and diagnostic data from the communications unit.

2. The aircraft maintenance and diagnostic data download system of Claim 1, wherein said data reception unit is in communication with said cellular infrastructure via a computer network.

3. The aircraft maintenance and diagnostic data download system of Claim 2, wherein the computer network is the Internet.

4. The aircraft maintenance and diagnostic data download system of Claim 1, wherein said data reception unit is in communication with said cellular
5 infrastructure via a telephone network.

5. The aircraft maintenance and diagnostic data download system of Claim 4, wherein the telephone network is a public switch telephone network.

10 6. The aircraft maintenance and diagnostic data download system of Claim 4, wherein the telephone network is an integrated services digital telephone network.

7. The aircraft maintenance and diagnostic data download system of any
15 one of Claims 1 to 6, wherein said communications unit includes:

an avionics input/output interface;

a processor that is connected to the avionics input/output interface;

a multi-port serial card in communication with said processor;

20 a plurality of cell channels in communication with said multi-port serial card; and

one or more antennas in communication with said cell channels.

8. The aircraft maintenance and diagnostic data download system of any
one of Claims 1 to 7, wherein said cellular infrastructure includes:

25 an antenna;

a transceiver subsystem in communication with said antenna; and

a controller in communication with said transceiver subsystem.

9. The aircraft maintenance and diagnostic data download system of any one of the preceding Claims 1, wherein said data reception unit includes:

- 5 a router; and
 a processor in communication with said router, said processor having a storage unit.

10. An aircraft maintenance and diagnostic data download system, comprising:

- an avionics system that comprises a plurality of avionics and/or electronic engine control line replaceable units, wherein one or more avionics and/or electronic engine control line replaceable unit stores aircraft maintenance and diagnostic data;
- 15 an avionics input/output interface that is connected each of the avionics and/or electronic engine control line replaceable units;
- a processor that is connected to the avionics input/output interface;
- a multi-port serial card that is connected to the processor; and
- a plurality of cell channels connected to the multi port serial card, said
- 20 cell channels for downloading aircraft maintenance and diagnostic data to a data reception unit via a cellular infrastructure after the aircraft has landed, wherein the data reception unit is remotely located from the aircraft, and wherein the communication between the cell channels and the multi port serial card is automatically initiated upon the landing of the aircraft.

25

11. An aircraft maintenance and diagnostic data download system of Claim 10, further comprising one or more antennas in communication with said cell channels.

12. An aircraft maintenance and diagnostic data download system of Claim 10 or 11, wherein the processor is a personal computer.

5 13. An aircraft maintenance and diagnostic data download system of Claim 10 or 11, wherein the processor is an application specific integrated circuit.

14. An aircraft maintenance and diagnostic data download system of
10 Claim 10 or 11, wherein the processor is a microprocessor.

15. An aircraft, comprising:
an avionics system having a plurality of avionics and/or electronic
engine control line replaceable units, wherein one or more avionics and/or
15 electronic engine control line replaceable unit stores aircraft maintenance and
diagnostic data; and

a communication unit, wherein the communications unit is used for
downloading the aircraft maintenance and diagnostic data, and the
communication unit is connected to one or more of the line replaceable units,
20 and wherein the communication unit comprises:

an avionics input/output interface;
a processor connected to the avionics input/output interface;
a multi-port serial card connected to the processor; and
a plurality of cell channels connected to the multi port serial card, said
25 cell channels for downloading aircraft maintenance and diagnostic data to a
data reception unit that is remotely located from the aircraft via a cellular
infrastructure after the aircraft has landed, wherein the communication between
the cell channels and the multi port serial card is automatically initiated upon
the landing of the aircraft.

16. An aircraft maintenance and diagnostic data download system, the aircraft having an avionics system, comprising:

- 5 means for transmitting data from the avionics system via a cellular infrastructure after the aircraft has landed, wherein the transmission of the data is initiated automatically upon landing of the aircraft; and
means for receiving said data from said cellular infrastructure.

10 17. An aircraft maintenance and diagnostic data download system of Claim 16, wherein said means for transmitting data includes a processor.

18. An aircraft maintenance and diagnostic data download system of Claim 16 or 17, wherein said means for receiving data includes a processor.

15

19. A method of downloading maintenance and diagnostic data from an aircraft, comprising:

at the aircraft;

receiving the maintenance and diagnostic data from a plurality of

20 avionics and/or electronic engine control line replaceable units;

downloading the maintenance and diagnostic data via a cellular communications infrastructure after the aircraft has landed, wherein the cellular communications infrastructure is accessed automatically upon landing of the aircraft; and

25 at a data reception unit, receiving the downloaded maintenance and diagnostic data, wherein the data reception unit is remotely located from the aircraft.

20. A method of downloading maintenance and diagnostic data from an avionics system located on an aircraft, comprising:

5 receiving the maintenance and diagnostic data from a plurality of avionics and/or electronic engine control line replaceable units;

processing maintenance and diagnostic data; and

10 downloading the processed maintenance and diagnostic data to a data reception unit that is remotely located from the aircraft via a cellular infrastructure after the aircraft has landed, wherein the cellular infrastructure is accessed automatically upon landing of the aircraft.

21. The method of Claim 20, further comprising receiving said transmitted data at a flight operations centre.

15

22. The method of Claim 20, further comprising receiving said transmitted data at a flight operations centre via a computer network.

20 23. The method of Claim 20, further comprising receiving said transmitted data at a flight operations centre via a telephone network.

24. The method of any one of Claims 17 to 23, wherein processing said data includes:

compressing the data;

25 encrypting the data;

segmenting the data; and

constructing packets of data from said segmented data.

25. The method of Claim 20 or any Claims dependent thereon, wherein receiving said transmitted data includes:

- 5 acknowledging receipt of said transmitted data;
- reassembling said received data;
- decrypting said reassembled data;
- uncompressing said decrypted data; and
- storing said uncompressed data.

10

26. A method of downloading maintenance and diagnostic data from an aircraft, comprising:

- receiving maintenance and diagnostic data from a plurality of avionics
and/or electronic engine control line replaceable units;
- 15 processing the maintenance and diagnostic data; and
- downloading the processed maintenance and diagnostic data to a data
reception unit that is remotely located from the aircraft via a cellular
infrastructure after the aircraft has landed, wherein processing said data
includes;
- 20 receiving a signal which indicates that the data downloading process can
begin;
- initiating a data transfer;
- compressing said data;
- encrypting said compressed data;
- 25 creating a packet queue;
- starting a primary data thread;
- waiting a predetermined period of time;
- determining if any threads are active;

repeating, when threads are active, the steps of waiting a predetermined period of time and determining if any threads are active; and
 5 exiting processing said data when no threads are active.

27. The method of Claim 26 wherein starting a primary data thread includes:

initiating a PPP connection;

initiating a transfer session;

10 starting at least one secondary data thread;

determining if data remains in the primary data thread;

~~sending said data when data remains in the primary data thread;~~

determining if data threads are active when no data remains in the primary data thread;

15 repeating, when said threads are active, the step of determining if data remains in the primary data thread;

ending said session when no threads are active;

closing said PPP connection; and

20 exiting starting a primary data thread.

28. The method of Claim 27 wherein starting at least one secondary data thread includes:

(a) setting the secondary data thread to active;

(b) initiating a PPP connection;

25 (c) determining if data remains in the secondary data thread;

(d) sending a data packet when data remains;

(e) repeating step c when data remains;

(f) closing said PPP connection when no data remains;

- (g) setting the secondary data thread to inactive;
- (h) exiting starting at least one secondary data thread; and
- 5 (i) repeating steps a through h for each secondary data thread.

29. The method of Claim 28, wherein repeating steps a through h includes repeating steps a through h in parallel for each said secondary data thread.

- 10 30. A computer-implemented method of downloading maintenance and diagnostic data from an aircraft, comprising:

- receiving the maintenance and diagnostic data from a plurality of
 avionics and/or electronic engine control line replaceable units;
- processing the maintenance and diagnostic data; and
- 15 downloading the processed data via a cellular infrastructure after the
 aircraft has landed; and
- receiving the downloaded maintenance and diagnostic data at a flight
 operations centre, wherein receiving said downloaded maintenance and
 diagnostic data includes;
- 20 creating a socket;
- receiving a message;
- determining if said message is an initialisation message;
- initiating a session when said message is an initialisation message;
- determining if said message is a data message when said message is not
- 25 an initialisation message;
- processing said message when said message is a data message;
- determining if said message is an end session when said message is not a
 data message;

30

processing said message when said message is a data message;
 determining if said message is an end session when said message is not a

5, data message;

processing said message when said message is an end session; and
 repeating, when said message is not an end session message, the step of
 receiving a message.

10 31. The method of Claim 30 wherein initiating a session includes:
 allocating buffer space;
 sending an initiation session acknowledgement; and
 returning to receiving a message.

15 32. The method of Claim 30 or 31, wherein processing said message when
 said message is a data message includes:
 copying said message to a buffer;
 sending a data message acknowledgement; and
 returning to receiving a message.

20

33. The method of Claim 30, wherein processing said message when said
 message is not an end session includes:

25 computing a checksum;
 determining if said checksum is valid;
 saving a buffer to a temporary file;
 decrypting said temporary file;
 uncompressing said temporary file;

sending an end session acknowledgement; and
returning to receiving a message.

5

34. An article of manufacture comprising a computer program carrier, readable by a processor and embodying one or more instructions executable by the processor to perform the method of downloading maintenance and diagnostic data from an avionics systems located on an aircraft, the method

10 comprising:

receiving maintenance and diagnostic data from a plurality of avionics and/or electronic engine control line replaceable units;

processing said maintenance and diagnostic data to prepare said data for downloading; and

15 downloading said processed maintenance and diagnostic data to a data reception unit that is remotely located from the aircraft via a cellular infrastructure when said aircraft has landed, wherein the cellular infrastructure is accessed automatically upon landing of the aircraft.

20 35. An aircraft maintenance data system substantially as herein described with reference to and as shown in the accompanying drawings.

36. A method of transmitting maintenance and diagnostic data substantially as herein described with reference to and as shown in the accompanying
25 drawings.

37. An aircraft substantially as herein described with reference to and as shown in the accompanying drawings.

5

38. An article of manufacture comprising a computer programme substantially as herein described with reference to and as shown in the accompanying drawings.





Teledyne Technologies Inc
c/o Forrester Ketley & Co
Forrester House
52 Bounds Green Road
LONDON
N11 2EY

**The Patent Office
Patents Directorate**

Concept House
Cardiff Road, Newport
South Wales, NP10 8QQ

Examiner: 01633 813684
E-Mail: nigel.hall@patent.gov.uk
Switchboard: 01633 814000
Fax: 01633 814444
Minicom: 08459 222250
DX: 722540/41 Cleppa Park 3
<http://www.patent.gov.uk>

Your Reference: P18136GB-NF/jsd
Application No: GB0323990.2

16 November 2005

Dear Sirs

Patents Act 1977: Examination Report under Section 18(3)

Latest date for reply:

16 January 2006

I have re-examined your application in response to your agent's letter of 15 November 2005 and enclose two copies of my further examination report.

By the above date you should either file amendments to meet the objections in the enclosed report or make observations on them. If you do not, the application may be refused.

Yours faithfully

Mr Nigel Hall
Examiner



INVESTOR IN PEOPLE

Your ref : P18136GB-NF/jsd
Application No: GB0323990.2
Applicant : Teledyne Technologies Inc

Examiner : Mr Nigel Hall
Tel : 01633 813684
Date of report : 16 November 2005

Latest date for reply: 16 January 2006

Page 1/1

Patents Act 1977

Examination Report under Section 18(3)

Basis of the examination

1. My examination has taken account of the amendments filed with your agent's letter of 30 September 2005.

Novelty

2. The invention, as defined by the new claims is considered to be novel and no longer anticipated by WO 03/092310, which lies in the s. 2(3) field.

Inventive step

3. It is argued in your agent's letter that the claims are inventively distinguished from the cited US 6181990 because they relate to downloading maintenance and diagnostic data while the cited document discloses transmitting flight data. It appears to the examiner that the arrangement of US 6181990 lends itself to downloading of any data gathered by the on-board avionics, including such data as could assist with maintenance and diagnostics. Moreover, lines 21-28 of column 1 indicate that the flight data of the cited could indeed assist in such maintenance and diagnostics.

Accordingly, I am unable to accept your Agent's argument for waiving the objection.

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The Patent Office
Cardiff Road
NEWPORT
South Wales
NP10 8QQ

FORRESTER HOUSE
52 BOUNDS GREEN ROAD
LONDON N11 2EY

Telephone +44 (0)20-8889 6622
Fax (Gr 3) +44 (0)20-8881 1088
(Gr 4) +44 (0)20-8889 0131
E-mail fklondon@forresters.co.uk

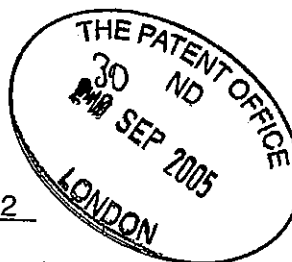
Our ref
P18136GB-NF/jsd

Your ref
GB 0323990.2

Date
30 September 2005

Dear Sirs

Re: British Patent Application No. 0323990.2
Teledyne Technologies Incorporated
Our Ref: P18136GB Your Ref: GB 0323990.2



We refer to the Official Letter of 30th March, 2005 and we now file in duplicate amended pages 3 to 11B of description to be substituted for pages 3 to 11 as at present on file, and a fresh page 21 of description to be substituted for pages 21 and 22 as at present on file, and fresh pages 22 to 32 to be substituted for the Claims as at present on file.

The passages identified by the Examiner on original pages 21 and 22 and Claim 41 have been deleted.

It is noted that the Examiner seeks to reject the Claims as originally filed on the ground of lack of novelty in view of WO 03/092,310 A1 ((Teledyne) and in view of lack of inventive step with regard to US 618,199 B1 (Grabawsky). It is respectfully submitted that the amended Claims, as now filed, are novel and inventive with regard to the prior art.

The Applicants' invention is directed to an aircraft maintenance and diagnostic data download system. The aircraft maintenance and diagnostic data download system comprises an aircraft that has an avionics system and a communication unit. The avionics system comprises a plurality of line replaceable units, and one or more of the line replaceable units store aircraft maintenance and diagnostic data. The communications unit is connected to one or more line replaceable units.

The avionics system also comprises a cellular infrastructure that is in communication with the communications unit after the aircraft has landed. The communications unit is used for downloading the aircraft maintenance and diagnostic data, and the communication is initiated automatically upon the landing of the aircraft.

Also at
6TH FLOOR, 105 PICCADILLY, LONDON W1J 7NJ
Tel : +44 (0)20-8889 6622 Fax : +44 (0)20-8889 0131

CHAMBERLAIN HOUSE, PARADISE PLACE, BIRMINGHAM B3 3HP
Tel : +44 (0) 121-236 0484 Fax : +44 (0) 121-233 1064

J D Brown BSc CPA RTMA N H Frankland BSc CPA RTMA C Cook RTMA FITMA D J Lucking BSc CPA RTMA MITMA J V Cowshall BSc CPA S J Wake BSc CPA RTMA MITMA
D M Wardley BSc PhD CPhys MInstP CPA RTMA MITMA L D C Hoarton BEng CPA K Richardson MA Cantab CPA M N Shaw BSc CPA S J Leno RTMA MITMA
R A Lockey BSc PhD AMInstP CPA S J Parry BEng CPA A T S Beattie MSc CPA

Associates: J C Carstairs BSc CPA G M Dodd BSc CPA A C Lawson MA DPhil Oxon CPA R Armstrong BSc PhD CPhys MInstP CPA

Records: J S Emery
Consultants: C A Howden CPA RTMA W Lally CPA Administration Manager: C A Willis BSc (Econ)
Representation at the European Patent Office FORRESTER & BOEHMERT A L Meddle BSc CPA RTMA
Pettenkoferstrasse 20-22 D-80336 München

VAT Registration No. GB-110 0242 58
Computer Systems: N G Mouzykantskii MSc (Moscow)
Website: www.forresters.co.uk

Exhibit 2 Part 1

Further, the avionics system comprises a data reception unit that is connected to the cellular infrastructure. The data reception unit is remotely located from the aircraft, and the data reception unit receives the aircraft maintenance and diagnostic data from the communications unit.

The Applicants' invention is also directed to a method of downloading maintenance and diagnostic data from an aircraft. At the aircraft, maintenance and diagnostic data is received from a plurality line replaceable units. The maintenance and diagnostic data is then downloaded via a cellular communications infrastructure after the aircraft has landed. The cellular communications infrastructure is accessed automatically upon landing of the aircraft. The downloaded maintenance and diagnostic data is received at a data reception unit. The data reception unit is remotely located from the aircraft.

WO 03/092310 A1

WO 03/092310 A1 (the '310 patent) discloses an aircraft transmission system. The aircraft transmissions system is used to upload software and database changes to the aircraft avionics system. An upload may include installing new software releases and operational databases into on-board avionics subsystems. The aircraft transmission system has a communications device located in an aircraft; an avionics information storage device located in the aircraft and in communication with the communications device and a cellular infrastructure; a computer remotely located from the aircraft and in communication with the cellular infrastructure. At least one of the communications devices and the computer is used for establishing a bi-directional communications channel via the cellular infrastructure between the communications device and the computer and initiating a data exchange therebetween.

U.S. 6181 990

U.S. Patent No. 6, 181, 990 (the '990 patent) discloses an aircraft data transmission system. The aircraft data transmission system is used to transfer flight data to a flight operations centre. Flight data typically refers to parameters such as air speed, altitude, vertical acceleration, heading and time parameters.. The aircraft data transmission system has an acquisition unit. It also includes a communications unit located in the aircraft and in communication with the data acquisition unit. The system further includes a cellular infrastructure in communication with the data communications unit after the aircraft has landed, and a data reception unit in communication with the cellular infrastructure. Once the cellular connections are made, data can flow bidirectionally from or to the aircraft.

The '310 Patent and '990 Patent as Compared to the Applicants' Independent Claims

The Examination Report cited the '310 patent and '990 patent against Claims 1 through 36. The Applicants respectfully assert that independent Claims 1, 12, 17-18, 21-22, 28, 32 and 36-40. are patentable over the '310 patent and the '990 patent. More specifically, the Applicants respectfully submit that independent Claims 1, 12, 17-18, 21-22, 28, 32 and 36-40 are not anticipated nor rendered obvious by the cited references, taken individually or in combination.

The '310 patent discloses uploading software and database changes to the aircraft avionics system, such as changes to a Navigation database, via a cellular infrastructure.

While, the '990 patent discloses **transmitting flight data**, such as air speed, altitude, vertical acceleration, heading and time parameters to a **flight operations center** via a cellular infrastructure.

Unlike the Applicants' invention, neither the '310 patent nor the '990 patent discusses or refers to the **downloading of maintenance and diagnostic data**. More specifically, the '310 patent discusses software and database changes, and the '990 patent discusses flight data. Maintenance and diagnostic data is different from software and database changes, and maintenance and diagnostic data is also different from flight data. In particular, maintenance and diagnostic data is used to repair an aircraft. On the other hand, the software and database changes help the aircraft operate more efficiently, and flight data is used to evaluate the aircraft's flight performance.

Clearly, neither of the cited references teach, suggest or disclose **downloading maintenance and diagnostic data** to a data unit that is remotely located from the aircraft as described in the Applicants' independent Claims 1, 12, 17-18, 21-22, 28, 32 and 36-40.

In light of the difference discussed above, the Applicants submit that independent Claims 1, 12, 17-18, 21-22, 28, 32 and 36-40, and hence all the Claims dependent thereon, recite novel physical and functional features that patently distinguish over any and all references. Moreover the dependent Claims recite additional novel structures, functions, and steps that are even more remote from the teachings of the cited references.

We trust that the Application will now be found to be in order for Grant.

Yours faithfully

FORRESTER KETLEY & CO



Thus, there is a need for an aircraft maintenance/diagnostics download system that automatically transfers aircraft/engine and maintenance/diagnostic data to the airline's or operator's maintenance and engineering centre with little or no human involvement, and which relies on a widely available and reliable public wireless, public switch telephone network (PSTN), integrated services digital network (ISDN), and/or Internet delivery systems.

10 The present invention, which addresses this need, resides in a system, method and an article of manufacture for transmitting maintenance and diagnostic data from an aircraft.

According to one aspect of this invention there is provided an aircraft maintenance and diagnostic data download system, comprising:

15 an aircraft having an avionics system and a communication unit, wherein the avionics system comprises a plurality of line replaceable units, wherein one or more line replaceable unit stores aircraft maintenance and diagnostic data, and wherein the communications unit is connected to one or more line replaceable units;

20 a cellular infrastructure in communication with said communications unit after the aircraft has landed, wherein the communications unit is used for downloading the aircraft maintenance and diagnostic data, and wherein the communication is initiated automatically upon the landing of the aircraft; and

25 a data reception unit, connected to the cellular infrastructure, wherein the data reception unit is remotely located from the aircraft, and wherein the data reception unit receives the aircraft maintenance and diagnostic data from the communications unit.

4

Preferably the line replaceable unit is an avionics line replaceable unit.

5 Conveniently the line replaceable unit is a an electronic engine control line replaceable unit.

Advantageously said data reception unit is in communication with said cellular infrastructure via a computer network.

10

Preferably the computer network is the Internet.

Conveniently said data reception unit is in communication with said cellular infrastructure via a telephone network.

15

Preferably the telephone network is a public switch telephone network.

Advantageously the telephone network is an integrated services digital telephone network.

20

Preferably said communications unit includes:

an avionics input/output interface;

a processor that is connected to the avionics input/output interface;

a multi-port serial card in communication with said processor;

25 a plurality of cell channels in communication with said multi-port serial card; and

one or more antennas in communication with said cell channels.

5

Conveniently said cellular infrastructure includes:

an antenna;

- 5 a transceiver subsystem in communication with said antenna; and
a controller in communication with said transceiver subsystem.

Advantageously said data reception unit includes:

a router; and

- 10 a processor in communication with said router, said processor having a
storage unit.

According to another aspect of this invention there is provided an
aircraft maintenance and diagnostic data download system, comprising:

- 15 an avionics system that comprises a plurality of line replaceable units,
wherein one or more line replaceable unit stores aircraft maintenance and
diagnostic data;

an avionics input/output interface that is connected each of the line
replaceable units;

- 20 a processor that is connected to the avionics input/output interface;
a multi-port serial card that is connected to the processor; and

a plurality of cell channels connected to the multi port serial card, said
cell channels for downloading aircraft maintenance and diagnostic data to a
data reception unit via a cellular infrastructure after the aircraft has landed,
25 wherein the data reception unit is remotely located from the aircraft, and
wherein the communication between the cell channels and the multi port serial
card is automatically initiated upon the landing of the aircraft.

6

The system may further comprise one or more antennas in communication with said cell channels.

5

Advantageously the processor is a personal computer.

Alternatively the processor is an application specific integrated circuit.

10

Alternatively the processor is a microprocessor.

The invention also relates to an aircraft, comprising:

an avionics system having a plurality of line replaceable units, wherein one or more line replaceable unit stores aircraft maintenance and diagnostic data; and

15

a communication unit, wherein the communications unit is used for downloading the aircraft maintenance and diagnostic data, and the communication unit is connected to one or more of the line replaceable units, and wherein the communication unit comprises:

20

an avionics input/output interface;

a processor connected to the avionics input/output interface;

a multi-port serial card connected to the processor; and

a plurality of cell channels connected to the multi port serial card, said cell channels for downloading aircraft maintenance and diagnostic data to a data reception unit that is remotely located from the aircraft via a cellular infrastructure after the aircraft has landed, wherein the communication between the cell channels and the multi port serial card is automatically initiated upon the landing of the aircraft.

25

7

The invention further relates to an aircraft maintenance and diagnostic data download system, the aircraft having an avionics system, comprising:

- 5 means for transmitting data from the avionics system via a cellular infrastructure after the aircraft has landed, wherein the transmission of the data is initiated automatically upon landing of the aircraft; and
- means for receiving said data from said cellular infrastructure.

- 10 Conveniently said means for transmitting data includes a processor.

Preferably said means for receiving data includes a processor.

- The invention also relates to a method of downloading maintenance and diagnostic data from an aircraft, comprising:
- 15 at the aircraft;

receiving the maintenance and diagnostic data from a plurality line replaceable units;

- downloading the maintenance and diagnostic data via a cellular communications infrastructure after the aircraft has landed, wherein the cellular communications infrastructure is accessed automatically upon landing of the aircraft; and
- 20

- at a data reception unit, receiving the downloaded maintenance and diagnostic data, wherein the data reception unit is remotely located from the aircraft.
- 25

In a further embodiment the invention relates to a method of downloading maintenance and diagnostic data from an avionics system located on an aircraft, comprising:

receiving the maintenance and diagnostic data from a plurality of line replaceable units;

5 processing maintenance and diagnostic data; and
downloading the processed maintenance and diagnostic data to a data reception unit that is remotely located from the aircraft via a cellular infrastructure after the aircraft has landed, wherein the cellular infrastructure is accessed automatically upon landing of the aircraft.

10

The method may further comprise receiving said transmitted data at a flight operations centre.

15 Alternatively the method may further comprise receiving said
transmitted data at a flight operations centre via a computer network.

Alternatively the method may further comprise receiving said transmitted data at a flight operations centre via a telephone network.

20

Preferably processing said data includes:

compressing the data;

encrypting the data;

segmenting the data; and

constructing packets of data from said segmented data.

25

Conveniently receiving said transmitted data includes:

acknowledging receipt of said transmitted data;

reassembling said received data;

decrypting said reassembled data;
uncompressing said decrypted data; and
storing said uncompressed data.

5

The invention may be considered to relate to a method of downloading maintenance and diagnostic data from an aircraft, comprising:

receiving maintenance and diagnostic data from a plurality of line replaceable units;

10

processing the maintenance and diagnostic data; and
downloading the processed maintenance and diagnostic data to a data reception unit that is remotely located from the aircraft via a cellular infrastructure after the aircraft has landed, wherein processing said data includes;

15

receiving a signal which indicates that the data downloading process can begin;

initiating a data transfer;

compressing said data;

encrypting said compressed data;

20

creating a packet queue;

starting a primary data thread;

waiting a predetermined period of time;

determining if any threads are active;

repeating, when threads are active, the steps of waiting a predetermined

25

period of time and determining if any threads are active; and

exiting processing said data when no threads are active.

10

Preferably starting a primary data thread includes:

- initiating a PPP connection;
- 5 initiating a transfer session;
- starting at least one secondary data thread;
- determining if data remains in the primary data thread;
- sending said data when data remains in the primary data thread;
- determining if data threads are active when no data remains in the
- 10 primary data thread;
- repeating, when said threads are active, the step of determining if data remains in the primary data thread;
- ending said session when no threads are active;
- closing said PPP connection; and
- 15 exiting starting a primary data thread.

Conveniently starting at least one secondary data thread includes:

- (a) setting the secondary data thread to active;
- (b) initiating a PPP connection;
- 20 (c) determining if data remains in the secondary data thread;
- (d) sending a data packet when data remains;
- (e) repeating step c when data remains;
- (f) closing said PPP connection when no data remains;
- (g) setting the secondary data thread to inactive;
- 25 (h) exiting starting at least one secondary data thread; and
- (i) repeating steps a through h for each secondary data thread.

Advantageously repeating steps a through h includes repeating steps a through h in parallel for each said secondary data thread.

5 The invention also relates to a computer-implemented method of downloading maintenance and diagnostic data from an aircraft, comprising:

receiving the maintenance and diagnostic data from a plurality of line replaceable units;

processing the maintenance and diagnostic data; and

10 downloading the processed data via a cellular infrastructure after the aircraft has landed; and

receiving the downloaded maintenance and diagnostic data at a flight operations centre, wherein receiving said downloaded maintenance and diagnostic data includes;

15 creating a socket;

receiving a message;

determining if said message is an initialisation message;

initiating a session when said message is an initialisation message;

20 determining if said message is a data message when said message is not an initialisation message;

processing said message when said message is a data message;

determining if said message is an end session when said message is not a data message;

processing said message when said message is a data message;

25 determining if said message is an end session when said message is not a data message;

processing said message when said message is an end session; and repeating, when said message is not an end session message, the step of receiving a message.

11A

Preferably initiating a session includes:

- allocating buffer space;
- 5 sending an initiation session acknowledgement; and
- returning to receiving a message.

Advantageously processing said message when said message is a data message includes:

- 10 copying said message to a buffer;
- sending a data message acknowledgement; and
- returning to receiving a message.

Preferably processing said message when said message is not an end session includes:

- 15 computing a checksum;
- determining if said checksum is valid;
- saving a buffer to a temporary file;
- decrypting said temporary file;
- 20 uncompressing said temporary file;
- sending an end session acknowledgement; and
- returning to receiving a message.

The invention also relates to an article of manufacture comprising a
25 computer program carrier; readable by a processor and embodying one or more instructions executable by the processor to perform the method of downloading maintenance and diagnostic data from an avionics systems located on an aircraft, the method comprising:

11B

receiving maintenance and diagnostic data from a plurality of line
5 replaceable units;

processing said maintenance and diagnostic data to prepare said data for
downloading; and

10 downloading said processed maintenance and diagnostic data to a data
reception unit that is remotely located from the aircraft via a cellular
infrastructure when said aircraft has landed, wherein the cellular infrastructure
is accessed automatically upon landing of the aircraft.

15 The system comprises an aircraft, a cellular infrastructures and a data
reception unit. The aircraft has an avionics system and a communications unit.
The avionics system comprises a plurality of line replaceable units. The
communications unit is connected to each line replaceable unit. The cellular
infrastructure is in communication with said communications unit after the
20 aircraft has landed. The communication is initiated automatically upon the
landing of the aircraft. The data reception unit is connected to the cellular
infrastructure.

layer 76 of the GroundLink computer 50 then decrypts the file at step 166 and uncompresses the file at step 168. The uncompressed file 78 is stored at step 170 by the operating system 72 on storage unit 52. The GroundLink
5 computer 50 sends an end session acknowledge message to the GroundLink processor 32 on aircraft 12 at step 174 and at step 178 the flow returns to step 134 of FIGURE 7. If the checksum is not correct, as determined at step 162, the GroundLink computer 50 sends an unsuccessful end session message (Nack) at step 176, which notifies the GroundLink processor 32 to re-
10 send the data and the flow returns to step 134 of FIGURE 7.

FIGURE 9 is a block diagram illustrating another embodiment of the system 10 illustrated in FIGURE 1. The operation of the system 10 of FIGURE 9 is similar to that described in conjunction with the system 10 of
15 FIGURE 2. However, the data that is transmitted by the GroundLink processor 32 via the cellular infrastructure 14 is routed by the public switched telephone network (PSTN) 210 to the modem bank 212. A modem bank 212 transmits the data to the GroundLink computer 50 via the local router 46 and local network 48. The modem bank 212 can have a modem dedicated to
20 receive data from each one of the cellular channels 36.

In the present Specification "comprises" means "includes or consists of" and "comprising" means "including or consisting of".

CLAIMS:

5

1. An aircraft maintenance and diagnostic data download system, comprising:

an aircraft having an avionics system and a communication unit, wherein the avionics system comprises a plurality of line replaceable units, wherein one
10 or more line replaceable unit stores aircraft maintenance and diagnostic data, and wherein the communications unit is connected to one or more line replaceable units;

a cellular infrastructure in communication with said communications unit after the aircraft has landed, wherein the communications unit is used for
15 downloading the aircraft maintenance and diagnostic data, and wherein the communication is initiated automatically upon the landing of the aircraft; and

a data reception unit, connected to the cellular infrastructure, wherein the data reception unit is remotely located from the aircraft, and wherein the data reception unit receives the aircraft maintenance and diagnostic data from
20 the communications unit.

2. The aircraft maintenance and diagnostic data download system of Claim 1, wherein the line replaceable unit is an avionics line replaceable unit.

25 3. The aircraft maintenance and diagnostic data download system of Claim 1, wherein the line replaceable unit is an electronic engine control line replaceable unit.

4. The aircraft maintenance and diagnostic data download system of Claim 1, 2 or 3, wherein said data reception unit is in communication with said
5 cellular infrastructure via a computer network.

5. The aircraft maintenance and diagnostic data download system of Claim 4, wherein the computer network is the Internet.

10 6. The aircraft maintenance and diagnostic data download system of Claim 1, 2 or 3, wherein said data reception unit is in communication with said cellular infrastructure via a telephone network.

15 7. The aircraft maintenance and diagnostic data download system of Claim 6, wherein the telephone network is a public switch telephone network.

8. The aircraft maintenance and diagnostic data download system of Claim 6, wherein the telephone network is an integrated services digital telephone network.

20

9. The aircraft maintenance and diagnostic data download system of any one of Claims 1 to 8, wherein said communications unit includes:

- an avionics input/output interface;
- a processor that is connected to the avionics input/output interface;
- 25 a multi-port serial card in communication with said processor;
- a plurality of cell channels in communication with said multi-port serial card; and
- one or more antennas in communication with said cell channels.

10. The aircraft maintenance and diagnostic data download system of any one of Claims 1 to 9, wherein said cellular infrastructure includes:
an antenna;
5 a transceiver subsystem in communication with said antenna; and
a controller in communication with said transceiver subsystem.
11. The aircraft maintenance and diagnostic data download system of any one of the preceding Claims 1, wherein said data reception unit includes:
10 a router; and
a processor in communication with said router, said processor having a storage unit.
12. An aircraft maintenance and diagnostic data download system,
15 comprising:
an avionics system that comprises a plurality of line replaceable units, wherein one or more line replaceable unit stores aircraft maintenance and diagnostic data;
an avionics input/output interface that is connected each of the line
20 replaceable units;
a processor that is connected to the avionics input/output interface;
a multi-port serial card that is connected to the processor; and
a plurality of cell channels connected to the multi port serial card, said cell channels for downloading aircraft maintenance and diagnostic data to a
25 data reception unit via a cellular infrastructure after the aircraft has landed, wherein the data reception unit is remotely located from the aircraft, and wherein the communication between the cell channels and the multi port serial card is automatically initiated upon the landing of the aircraft.

13. An aircraft maintenance and diagnostic data download system of
Claim 12, further comprising one or more antennas in communication with said
5 cell channels.

14. An aircraft maintenance and diagnostic data download system of
Claim 12 13, wherein the processor is a personal computer.

10 15. An aircraft maintenance and diagnostic data download system of
Claim 12 or 13, wherein the processor is an application specific integrated
circuit.

16. An aircraft maintenance and diagnostic data download system of
15 Claim 12 or 13, wherein the processor is a microprocessor.

17. An aircraft, comprising:
an avionics system having a plurality of line replaceable units, wherein
one or more line replaceable unit stores aircraft maintenance and diagnostic
20 data; and

a communication unit, wherein the communications unit is used for
downloading the aircraft maintenance and diagnostic data, and the
communication unit is connected to one or more of the line replaceable units,
and wherein the communication unit comprises:

25 an avionics input/output interface;
a processor connected to the avionics input/output interface;
a multi-port serial card connected to the processor; and
a plurality of cell channels connected to the multi port serial card, said
cell channels for downloading aircraft maintenance and diagnostic data to a

data reception unit that is remotely located from the aircraft via a cellular infrastructure after the aircraft has landed, wherein the communication between the cell channels and the multi port serial card is automatically initiated upon the landing of the aircraft.

18. An aircraft maintenance and diagnostic data download system, the aircraft having an avionics system, comprising:

means for transmitting data from the avionics system via a cellular infrastructure after the aircraft has landed, wherein the transmission of the data is initiated automatically upon landing of the aircraft; and
means for receiving said data from said cellular infrastructure.

19. An aircraft maintenance and diagnostic data download system of Claim 18, wherein said means for transmitting data includes a processor.

20. An aircraft maintenance and diagnostic data download system of Claim 18 or 19, wherein said means for receiving data includes a processor.

21. A method of downloading maintenance and diagnostic data from an aircraft, comprising:

at the aircraft;
receiving the maintenance and diagnostic data from a plurality line replaceable units;

downloading the maintenance and diagnostic data via a cellular communications infrastructure after the aircraft has landed, wherein the cellular communications infrastructure is accessed automatically upon landing of the aircraft; and

at a data reception unit, receiving the downloaded maintenance and diagnostic data, wherein the data reception unit is remotely located from the aircraft.

5

22. A method of downloading maintenance and diagnostic data from an avionics system located on an aircraft, comprising:

receiving the maintenance and diagnostic data from a plurality of line replaceable units;

10

processing maintenance and diagnostic data; and
downloading the processed maintenance and diagnostic data to a data reception unit that is remotely located from the aircraft via a cellular infrastructure after the aircraft has landed, wherein the cellular infrastructure is accessed automatically upon landing of the aircraft.

15

23. The method of Claim 22, further comprising receiving said transmitted data at a flight operations centre.

24. The method of Claim 22, further comprising receiving said transmitted
20 data at a flight operations centre via a computer network.

25. The method of Claim 22, further comprising receiving said transmitted data at a flight operations centre via a telephone network.

25 26. The method of any one of Claims 19 to 26, wherein processing said data includes:

compressing the data;

encrypting the data;

segmenting the data; and
constructing packets of data from said segmented data.

5 27. The method of Claim 22 or any Claims dependent thereon, wherein receiving said transmitted data includes:

acknowledging receipt of said transmitted data;
reassembling said received data;
decrypting said reassembled data;
10 uncompressing said decrypted data; and
storing said uncompressed data.

28. A method of downloading maintenance and diagnostic data from an aircraft, comprising:

15 receiving maintenance and diagnostic data from a plurality of line replaceable units;

processing the maintenance and diagnostic data; and

downloading the processed maintenance and diagnostic data to a data reception unit that is remotely located from the aircraft via a cellular
20 infrastructure after the aircraft has landed, wherein processing said data includes;

receiving a signal which indicates that the data downloading process can begin;

initiating a data transfer;

25 compressing said data;

encrypting said compressed data;

creating a packet queue;

starting a primary data thread;

29

waiting a predetermined period of time;
determining if any threads are active;
repeating, when threads are active, the steps of waiting a predetermined
5 period of time and determining if any threads are active; and
exiting processing said data when no threads are active.

29. The method of Claim 28 wherein starting a primary data thread includes:
initiating a PPP connection;
10 initiating a transfer session;
starting at least one secondary data thread;
determining if data remains in the primary data thread;
sending said data when data remains in the primary data thread;
determining if data threads are active when no data remains in the
15 primary data thread;
repeating, when said threads are active, the step of determining if data
remains in the primary data thread;
ending said session when no threads are active;
closing said PPP connection; and
20 exiting starting a primary data thread.

30. The method of Claim 29 wherein starting at least one secondary data
thread includes:
(a) setting the secondary data thread to active;
25 (b) initiating a PPP connection;
(c) determining if data remains in the secondary data thread;
(d) sending a data packet when data remains;
(e) repeating step c when data remains;

30

- (f) closing said PPP connection when no data remains;
- (g) setting the secondary data thread to inactive;
- (h) exiting starting at least one secondary data thread; and
- 5 (i) repeating steps a through h for each secondary data thread.

31. The method of Claim 30, wherein repeating steps a through h includes repeating steps a through h in parallel for each said secondary data thread.

- 10 32. A computer-implemented method of downloading maintenance and diagnostic data from an aircraft, comprising:

receiving the maintenance and diagnostic data from a plurality of line replaceable units;

processing the maintenance and diagnostic data; and

- 15 downloading the processed data via a cellular infrastructure after the aircraft has landed; and

receiving the downloaded maintenance and diagnostic data at a flight operations centre, wherein receiving said downloaded maintenance and diagnostic data includes;

- 20 creating a socket;

receiving a message;

determining if said message is an initialisation message;

initiating a session when said message is an initialisation message;

- 25 determining if said message is a data message when said message is not an initialisation message;

processing said message when said message is a data message;

determining if said message is an end session when said message is not a data message;

processing said message when said message is a data message;

determining if said message is an end session when said message is not a data message;

5 processing said message when said message is an end session; and
repeating, when said message is not an end session message, the step of
receiving a message.

33. The method of Claim 32 wherein initiating a session includes:
10 allocating buffer space;
 sending an initiation session acknowledgement; and
 returning to receiving a message.

34. The method of Claim 32 or 33, wherein processing said message when
15 said message is a data message includes:
 copying said message to a buffer;
 sending a data message acknowledgement; and
 returning to receiving a message.

20 35. The method of Claim 32, wherein processing said message when said
message is not an end session includes:
 computing a checksum;
 determining if said checksum is valid;
 saving a buffer to a temporary file;
25 decrypting said temporary file;
 uncompressing said temporary file;
 sending an end session acknowledgement; and
 returning to receiving a message.

36. An article of manufacture comprising a computer program carrier, readable by a processor and embodying one or more instructions executable by the processor to perform the method of downloading maintenance and diagnostic data from an avionics systems located on an aircraft, the method comprising:

receiving maintenance and diagnostic data from a plurality of line replaceable units;

10 processing said maintenance and diagnostic data to prepare said data for downloading; and

downloading said processed maintenance and diagnostic data to a data reception unit that is remotely located from the aircraft via a cellular infrastructure when said aircraft has landed, wherein the cellular infrastructure is accessed automatically upon landing of the aircraft.

37. An aircraft maintenance data system substantially as herein described with reference to and as shown in the accompanying drawings.

20 38. A method of transmitting maintenance and diagnostic data substantially as herein described with reference to and as shown in the accompanying drawings.

39. An aircraft substantially as herein described with reference to and as shown in the accompanying drawings.

40. An article of manufacture comprising a computer programme substantially as herein described with reference to and as shown in the accompanying drawings.

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Cardiff Road
NEWPORT
South Wales
NP10 8QQ

FORRESTER HOUSE
52 BOUNDS GREEN ROAD
LONDON N11 2EY

Telephone +44 (0)20-8889 6622

Fax (Gr 3) +44 (0)20-8881 1088

(Gr 4) +44 (0)20-8889 0131

E-mail fklondon@forresters.co.uk

Received

1 8 JUL 2005

Formalities CA

Our ref

P18136GB - NHF/ns

Your ref

Date

15 July 2005

Dear Sirs

Re: British Patent Application No. 0323990.2
Teledyne Technologies Incorporated
Our Ref: P18136GB

We request a two month extension of the term for responding to the Examination Report of 30 March 2005.

At this time we do not have instructions from our principals in the USA and the Attorney responsible for this file is about to leave on a two week holiday.

Yours faithfully

FORRESTER KETLEY & CO

Also at
6TH FLOOR, 105 PICCADILLY, LONDON W1J 7NJ
Tel : +44 (0)20-8889 6622 Fax : +44 (0)20-8889 0131

CHAMBERLAIN HOUSE, PARADISE PLACE, BIRMINGHAM B3 3HP
Tel : +44 (0) 121-236 0484 Fax : +44 (0) 121-233 1064

J D Brown BSc CPA RTMA N H Frankland BSc CPA RTMA C Cook RTMA FITMA D J Lucking BSc CPA RTMA MITMA J V Cowshall BSc CPA S J Wake BSc CPA RTMA MITMA
D M Wardley BSc PhD CPhys MInstP CPA RTMA MITMA L D C Hoarton BEng CPA K Richardson MA Cantab CPA M N Shaw BSc CPA S J Leno RTMA MITMA
R A Lockey BSc PhD AMInstP CPA S J Parry BEng CPA A T S Beattie MSc CPA
Associates: J C Carstairs BSc CPA G M Dodd BSc CPA A C Lawson MA DPhil Oxon CPA R Armstrong BSc PhD CPhys MInstP CPA

Records: J S Emery
Consultants: C A Howden CPA RTMA W Lally CPA Administration Manager: C A Willis BSc (Econ)
Representation at the European Patent Office: FORRESTER & BOEHMERT A L Meddle BSc CPA RTMA
Pettenkoferstrasse 20-22 D-80336 München

VAT Registration No. GB-110 0242 58
Computer Systems: N G Mouzykantskii MSc (Moscow)
Website: www.forresters.co.uk

Exhibit 9 Part 1

Page 126



INVESTOR IN PEOPLE

Teledyne Technologies Inc
c/o Forrester Ketley & Co
Forrester House
52 Bounds Green Road
LONDON
N11 2EY

**The Patent Office
Patents Directorate**

Concept House
Cardiff Road, Newport
South Wales, NP10 8QQ

Examiner: 01633 813684
E-Mail: nigel.hall@patent.gov.uk
Switchboard: 01633 814000
Fax: 01633 814444
Minicom: 08459 222250
DX: 722540/41 Cleppa Park 3
<http://www.patent.gov.uk>

Your Reference: P18136GB-NF/jsd
Application No: GB0323990.2

30 March 2005

Dear Sirs

Patents Act 1977: Examination Report under Section 18(3)

Latest date for reply:

OK
1 August 2005

I enclose two copies of my examination report.

By the above date you should either file amendments to meet the objections in the enclosed report or make observations on them. If you do not, the application may be refused.

Yours faithfully,

Mr Nigel Hall
Examiner



Your ref : P18136GB-NF/jsd
Application No: GB0323990.2
Applicant : Teledyne Technologies Inc

Examiner : Mr Nigel Hall
Tel : 01633 813684
Date of report : 30 March 2005

Latest date for reply: 1 August 2005

Page 1/1

Patents Act 1977

Examination Report under Section 18(3)

Novelty

1. The invention as defined in claims 1-7, 9-36 is not new because it has already been disclosed in the following document:

WO 03/092310 A1 (Teledyne)

This document was found in updating the original search. No amendment of your claims will be needed in its respect if you can show that the priority date of your invention is not later than the priority date of the relevant disclosure in that document.

Inventive step

2. The invention as defined in claims 1-36 is obvious in view of what has already been disclosed in the following documents:

US 6181990 B1 (Grabowsky)

The claims, apart from claim 8, are distinguished from the disclosure of the cited document solely by the fact that the aircraft-borne avionics system comprises line replaceable units, to which the communications units are connected.

The use of ISDN to transfer the downloaded data to the flight operations centre (claim 8) does not appear inventive.

Other matters

3. Since the scope of protection is defined by the claims, the paragraphs of page 21, lines 21-29 and page 22, lines 5-10 are unnecessary. It is noted that the claims are limited to transferring data after the aircraft has landed, contrary to what is stated in the first of these paragraphs.

4. Claim 41 is of uncertain scope and should be deleted.



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Teledyne Technologies Inc
c/o Forrester Ketley & Co
Forrester House
52 Bounds Green Road
LONDON
N11 2EY

The Patent Office
Patents Directorate

Concept House
Cardiff Road
Newport
South Wales NP10 8QQ
United Kingdom

Your Reference: P18136GB-NF/jsd
Application Number: GB0323990.2

Direct line: 01633 814619
Switchboard: 01633 814000
Fax: 01633 814444
Minicom: 08459 222250
DX 722540/41 Cleppa Park 3
<http://www.patent.gov.uk>

9 November 2004

Dear Sir/Madam

Patents Act 1977
Outstanding Request for Substantive Examination

1. According to our records you have not yet requested substantive examination of your patent application.

What you must do next

2. If you decide to continue with your application you should send to this Office a request for substantive examination on Patents Form 10/77 with the prescribed fee of £70.00 so that both reach this Office by 26 November 2004.

3. You have the right to send us the Patents Form 10/77 and fee up to one month after that date but you will then have to pay an additional fee of £135.00. Further extensions of time beyond one month will be allowed only at the discretion of the Comptroller, provided you satisfy him that there are good reasons for the extension and provided you pay extra fees.

Warning

4. If we do not receive a request and fee for substantive examination your patent application will eventually be treated as having been withdrawn under Section 18(1) of the Patents Act 1977, and will be announced as terminated in The Patents and Designs Journal.

Yours faithfully

Andrew Cressey
ANDREW CRESSEY
Formalities Manager

OA59

F10R



INVESTOR IN PEOPLE

Teledyne Technologies Inc
c/o Forrester Ketley & Co
Forrester House
52 Bounds Green Road
LONDON
N11 2EY

The Patent Office
Patents Directorate

Concept House
Cardiff Road
Newport
South Wales NP10 8QQ
United Kingdom

Direct line: 08459 500505
Switchboard: 01633 814000
Fax: 01633 814827
Minicom: 08459 222250
DX 722540/41 Cleppa Park 3
<http://www.patent.gov.uk>

Your Reference: P18136GB-NF/jsd
Our Reference:

26 April 2004

Dear Sir/Madam

PATENTS ACT 1977: PATENTS RULES 1995
NOTICE OF PUBLICATION: APPLICATION NUMBER GB0323990.2

1. Your patent application will be published on **26 May 2004** with the publication number **GB2395634**. Preparations for publication will be complete (PPC) on **30 April 2004**. **WARNING** - after preparations for publication are complete it will NOT be possible to withdraw your application from publication. If you wish to withdraw your application to prevent publication you should do so **BEFORE** the PPC date. The withdrawal should be in writing to the address above or by email to withdraw@patent.gov.uk. Further information on withdrawing applications can be obtained from the Publication Liaison Officer by telephone on 01633 814089.
2. On the publication date, details of your application will be entered in the Register of Patents. From then onwards those details, and the application file, will be open to public inspection at the Patent Office, Concept House, Cardiff Road, Newport, South Wales, NP10 8QQ and at the Patent Office, Harmsworth House, 13-15 Bouverie Street, London, EC4Y 8DP.
3. **IMPORTANT:** If you want your application considered for grant of a patent, you must, if you have not already done so, ensure that a request for substantive examination on Patents Form 10/77, together with the required fee (currently £70.00), is received by the Patent Office within 6 months of the publication date, that is by **26 November 2004**. That period can be extended by one month by sending us Patents Form 52/77, together with the required additional fee (currently £135.00).
4. **IMPORTANT:** If the request and fee for substantive examination are not received by the Patent Office in time, your application will be treated as withdrawn.

[PLEASE TURN OVER]



Teledyne Technologies Inc.
% Forrester Ketley & Co
Forrester House
52 Bounds Green Road
LONDON
N11 2EY

**The Patent Office
Patents Directorate**

Concept House
Cardiff Road, Newport
South Wales NP10 8QQ

Examiner: 01633 814340
E-mail: steve.evans@patent.gov.uk
Switchboard: 01633 814000
Fax: 01633 814444
Minicom: 08459 222250
DX 722540/41 Cleppa Park 3
<http://www.patent.gov.uk>

Your Reference: P18136GB-NF/jsd
Application No: GB 0323990.2

22 March 2004

Dear Sirs

Patents Act 1977: Search Report under Section 17(5)

I enclose two copies of my search report and two copies of the citations.

Publication

I estimate that, provided you have met all the formal requirements, preparations for publication of your application will be completed soon after **20 April 2004**. At this time you will receive a letter confirming the exact date when the preparations for publication will be completed. This letter will also tell you the publication number and date of publication of your application.

Withdrawal/amendment

If you wish to withdraw your application before it is published you must do so before the preparations for publication are complete. **WARNING** - after preparations for publication are complete it will NOT be possible to withdraw your application from publication.

If you wish to file amended claims for inclusion with the published application you must do so before the preparations for publication are completed. If you write to the Office less than 3 weeks before 20 April 2004 please mark your letter prominently:

"URGENT - PUBLICATION IMMINENT".

Yours faithfully

Steve Evans
Examiner



Application No: GB 0323990.2
Claims searched: All

Examiner: Steve Evans
Date of search: 19 March 2004

Patents Act 1977 : Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance	
X	1, 12, 17, 18, 21, 22, 28, 32 & 36 at least	US 6181990 B1	(TELEDYNE) - Whole document
Y	1, 12, 17, 18, 21, 22, 28, 32 & 36 at least	US 6308045 B1	(HARRIS) - Whole document
Y	As above	US 6108523 A	(HARRIS) - Whole document
Y	As above	US 5974349 A	(LEVINE) - Whole document
Y	As above	GB 2345824 A	(MINORPLANET) - Whole document
A		EP 1280316 A3	(Aircraft Management Holdings) - Whole document

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^w:

H4L

Worldwide search of patent documents classified in the following areas of the IPC¹:

G06F; H04L

The following online and other databases have been used in the preparation of this search report:

EPODOC, JAPIO, WPI

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FORRESTER HOUSE
52 BOUNDS GREEN ROAD
LONDON N11 2EY

Telephone +44 (0)20-8889 6622
Fax (Gr 3) +44 (0)20-8881 1088
(Gr 4) +44 (0)20-8889 0131
E-mail fklondon@forresters.co.uk

Our ref
P18136GB-NF/jsd

Your ref
GB 0323990.2

Date
22 December, 2003

Dear Sirs,

24DEC03 8151417-1 000389
DOCS 0-00-0323990.2 NONE

Re: British Patent Application No. 0323990.2
Teledyne Technologies Incorporated
"Teledyne Technologies Incorporated"
Our Ref: P18136GB Your Ref: GB 0323990.2

In connection with this Application we now file a certified copy of U.S. Application 10/272,753 to support the Claim to Priority made in connection with this Application.

Yours faithfully,

FORRESTER KETLEY & CO.

Also at
CHAMBERLAIN HOUSE, PARADISE PLACE, BIRMINGHAM B3 3HP
Tel : +44 (0) 121-236 0484 Fax : +44 (0) 121-233 1064

J D Brown BSc CPA RTMA A L Meddle BSc CPA RTMA N H Frankland BSc CPA RTMA C Cook RTMA FITMA D J Lucking BSc CPA RTMA MITMA J V Cowshall BSc CPA
S J Wake BSc CPA RTMA MITMA D M Wardley BSc PhD CPhys MInstP CPA RTMA MITMA LD C Hoarton BEng CPA K Richardson MA Cantab CPA M N Shaw BSc CPA
S J Leno RTMA MITMA R A Lockey BSc PhD AMInstP CPA S J Parry BEng CPA

Associates: J C Carstairs BSc CPA G M Dodd BSc CPA

Assisted by: A T S Beattie MSci CPA

Financial Controller: R G Davies BA FCA

Consultants: J N Leach BSc MIM CPA RTMA
Representation at the European Patent Office

Administration Managers: C A Willis BSc (Econ)
CA Howden CPA RTMA MITMA W Lally CPA RTMA
FORRESTER & BOEHMERT Pettenkoferstrasse 20-22 D-80336 München

VAT Registration No. C8-110 0242 58
Computer Systems: N G Mouzykantskiy MSc (Moscow)
Website: www.forresters.co.uk

Exhibit Q - Part 1
Page 133



Teledyne Technologies Inc.
% Forrester Ketley & Co
Forrester House
52 Bounds Green Road
LONDON
N11 2EY

**The Patent Office
Patents Directorate**

Concept House
Cardiff Road, Newport
South Wales NP10 8QQ
United Kingdom

Direct line: 01633 814621
†E-mail: peter.manchee@patent.gov.uk
Switchboard: 01633 814000
Minicom: 08459 222250
Fax: 01633 814444
DX 722540/41 Cleppa Park 3
<http://www.patent.gov.uk>

**Your reference: P18136GB-NF/JSD
Application number: GB 0323990.2**

10 November 2003

Dear Sir(s)

PATENTS ACT 1977 : PATENTS RULES 1995

I enclose my Preliminary Examination report on your application.

You must either meet the requirements set out in my report or make observations on them by the date(s) given in the report. If you do not the application may be refused.

Any date marked with an asterisk (*) can be extended by one month with Form 52/77 and fee of £135.

Yours faithfully

Peter Manchee
Formalities Examiner

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**PRELIMINARY EXAMINATION REPORT UNDER SECTION 17(2)
APPLICATION NUMBER GB 0323990.2**

Your application does not meet with the requirements of the Patents Rules in the following matters. Please meet the requirements by the date or dates specified.

DECLARATION OF FOREIGN PRIORITY

You must file a copy of your earlier foreign application number(s) US 10/272,753 certified by the overseas patent office where it was filed by 17th February 2004.*

PLEASE NOTE NO FURTHER REMINDERS WILL BE ISSUED

End of report

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(71) Applicant(s):
 Teledyne Technologies Inc
 (Incorporated in USA - Delaware)
 12333 West Olympic Boulevard,
 Los Angeles, California 90064-1021,
 United States of America

(72) Inventor(s):
 Tamas M Igloi
 Ghobad Karimi

(74) Agent and/or Address for Service:
 Forrester Ketley & Co
 Forrester House, 52 Bounds Green Road,
 LONDON, N11 2EY, United Kingdom

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 H4L LRAXX

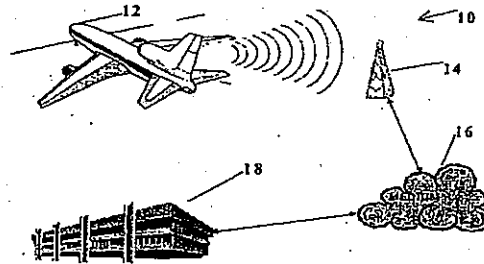
(56) Documents Cited:
 GB 2345824 A EP 1280316 A3
 US 6308045 B1 US 6181990 B1
 US 6108523 A US 5974349 A

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 UK CL (Edition W) H4L
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(54) Abstract Title: **Improvements in or relating to aircraft avionics maintenance diagnostics data download transmission system**

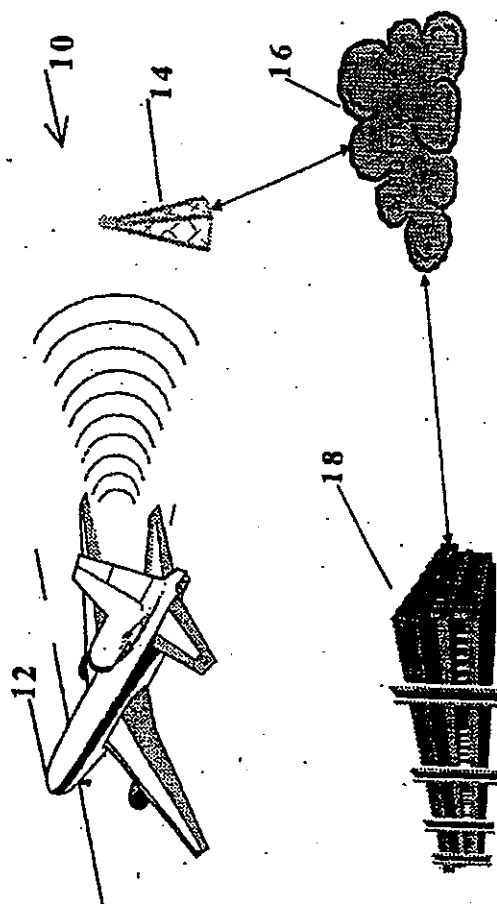
(57) The present invention resides in a system, method and an article of manufacture for transmitting maintenance and diagnostic data from an aircraft. The system comprises an aircraft, a cellular infrastructures and a data reception unit. The aircraft has an avionics system and a communications unit. The avionics system comprises a plurality of line replaceable units, and the communications unit is connected to each line replaceable unit. The cellular infrastructure is in communication with said communications unit after the aircraft has landed. The communication is initiated automatically upon the landing of the aircraft. The data reception unit is connected to the cellular infrastructure.

FIGURE 1

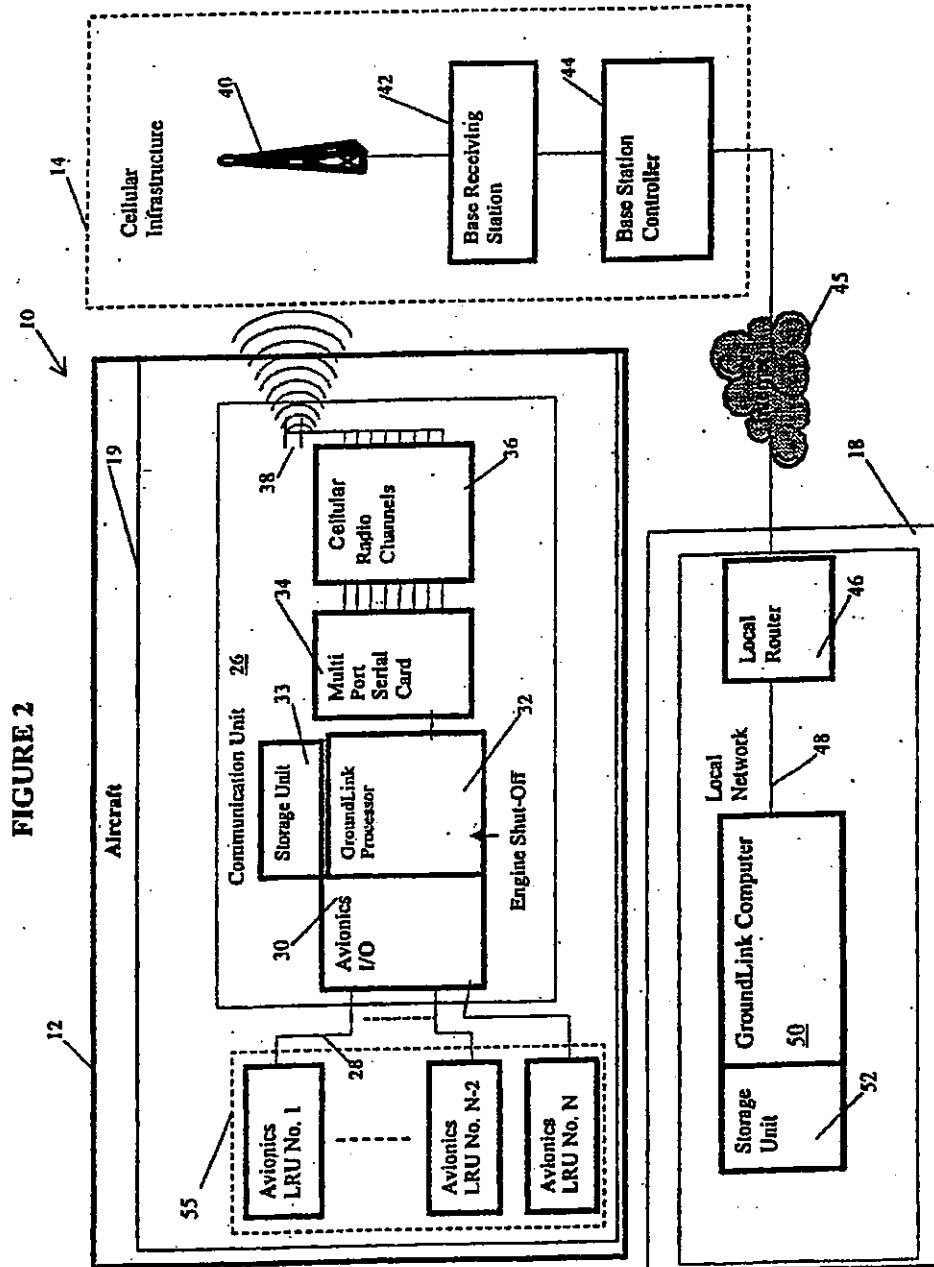
**GB 2 395 634 A**

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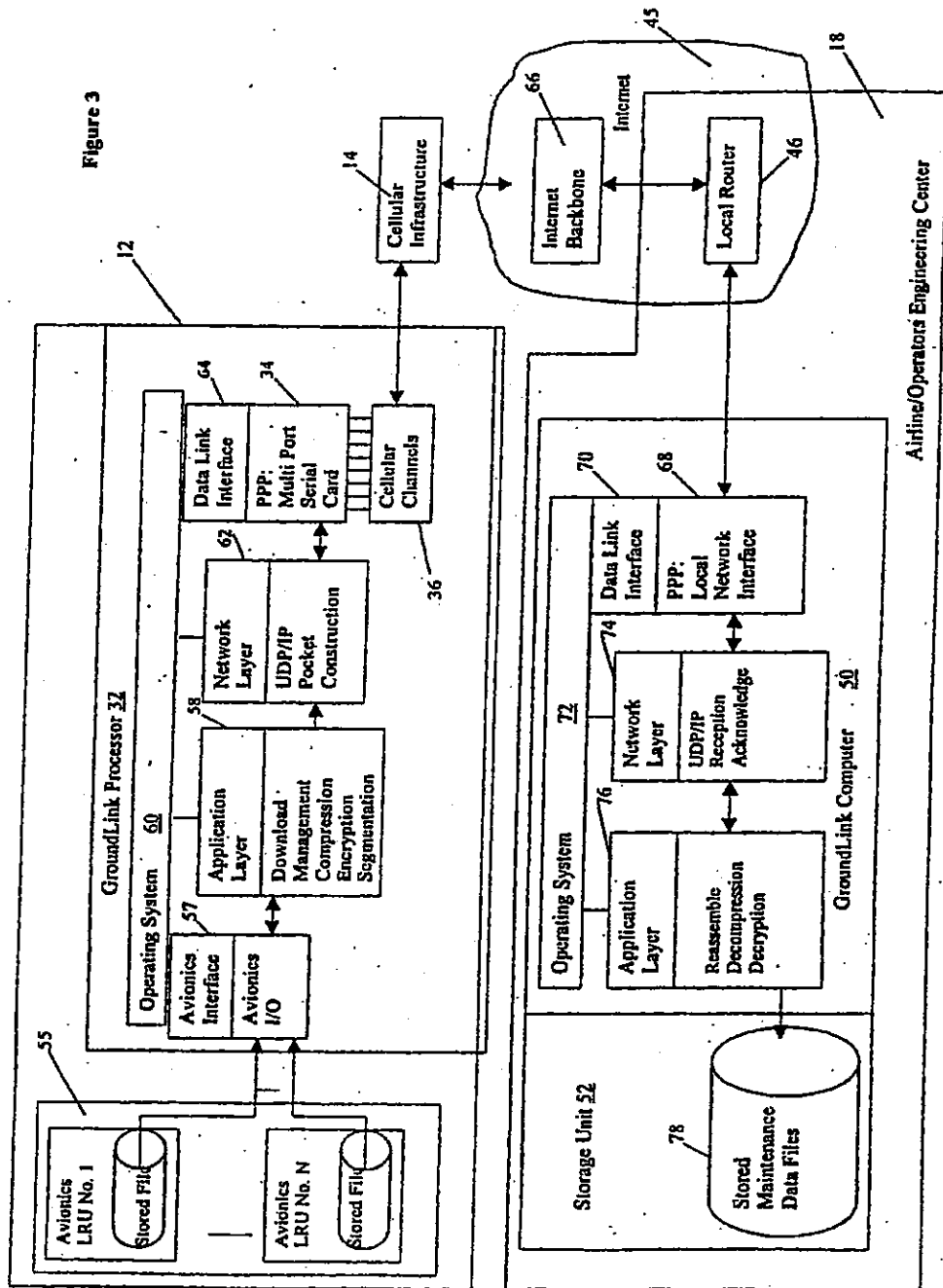
FIGURE 1



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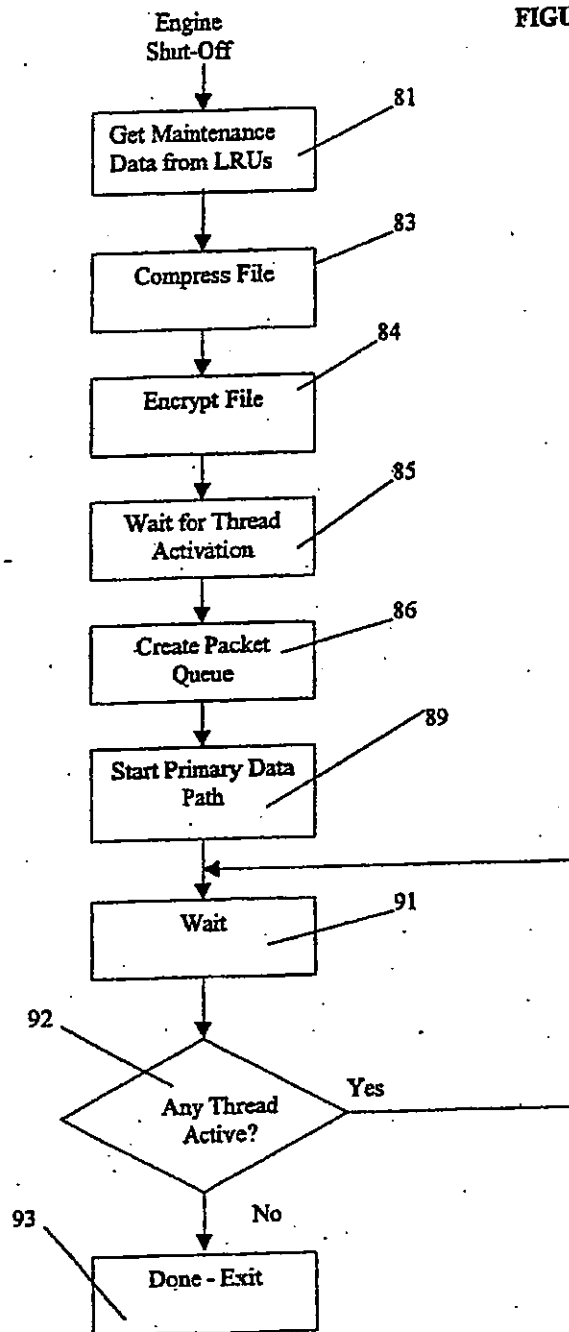


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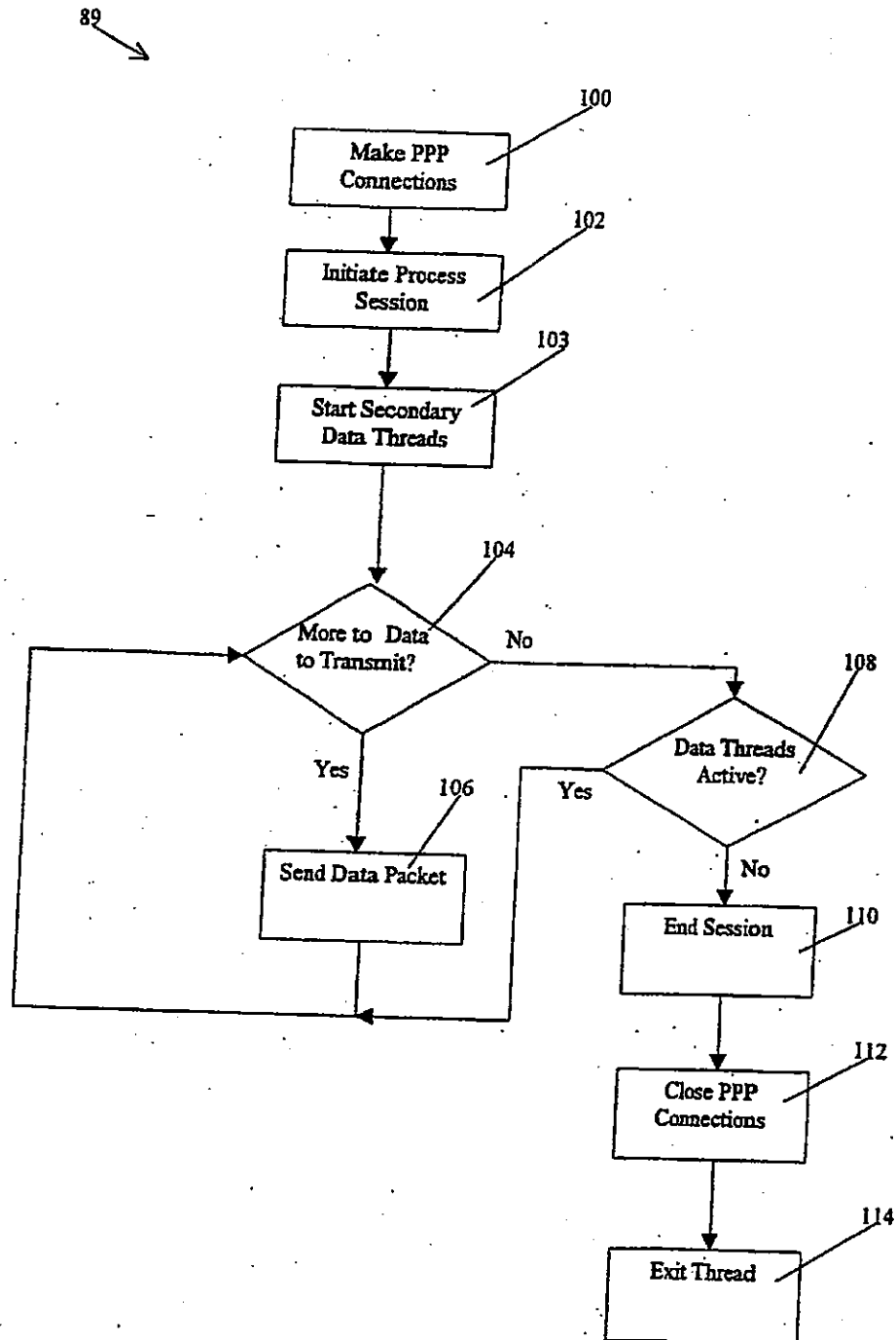
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FIGURE 4

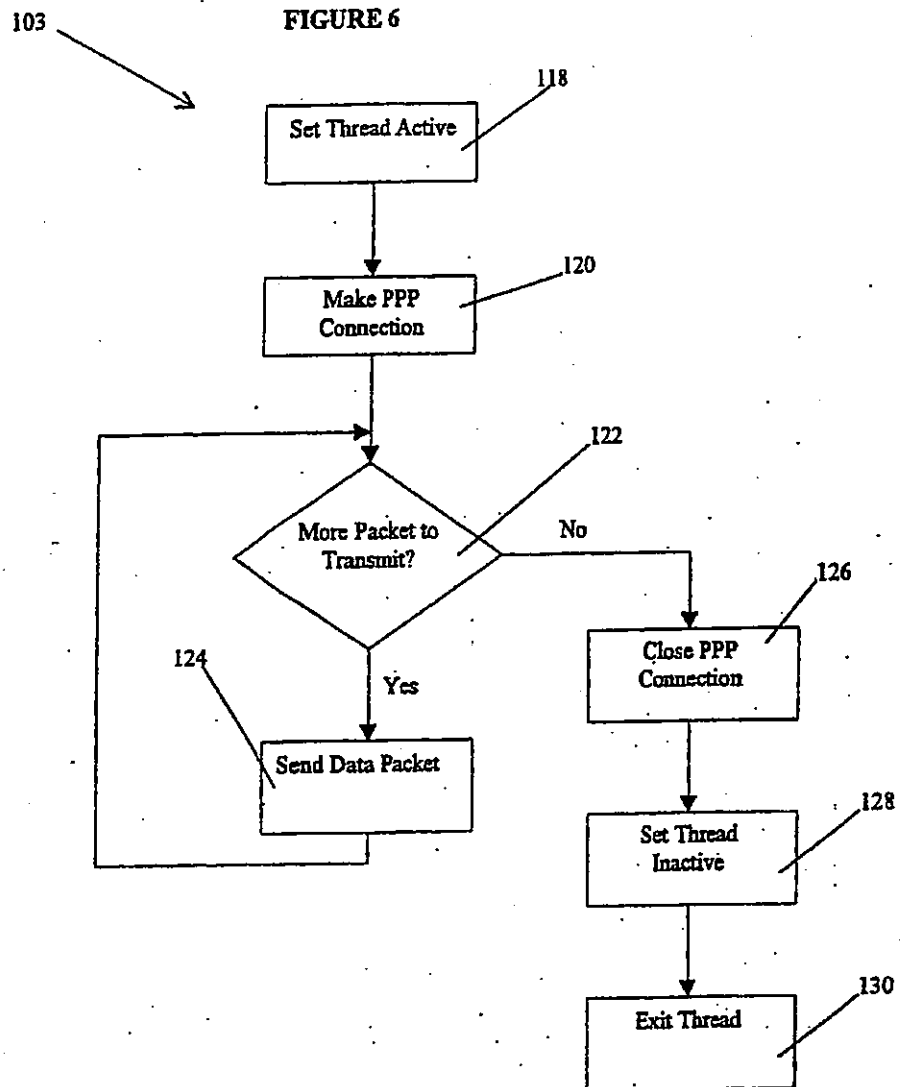


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FIGURE 5

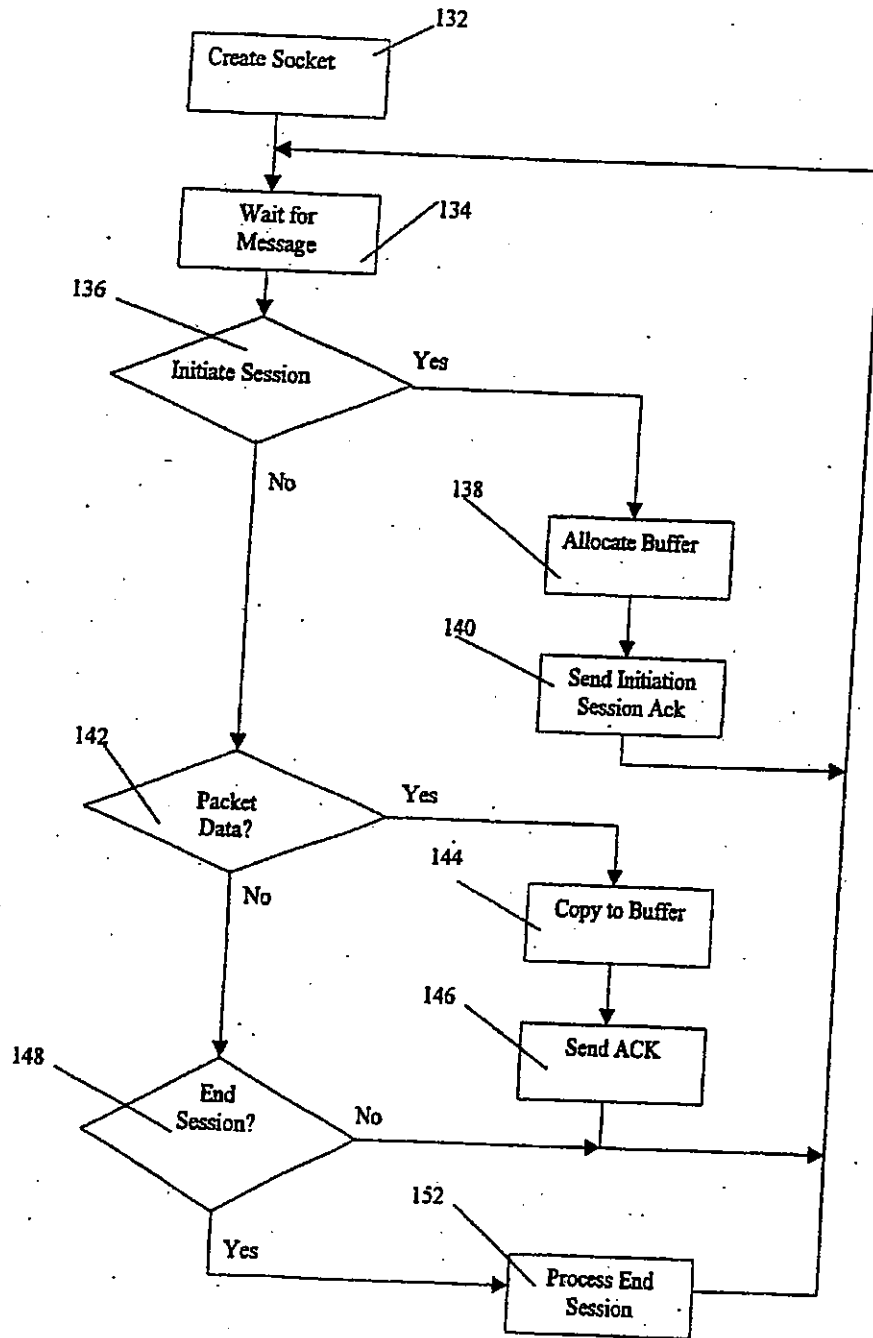


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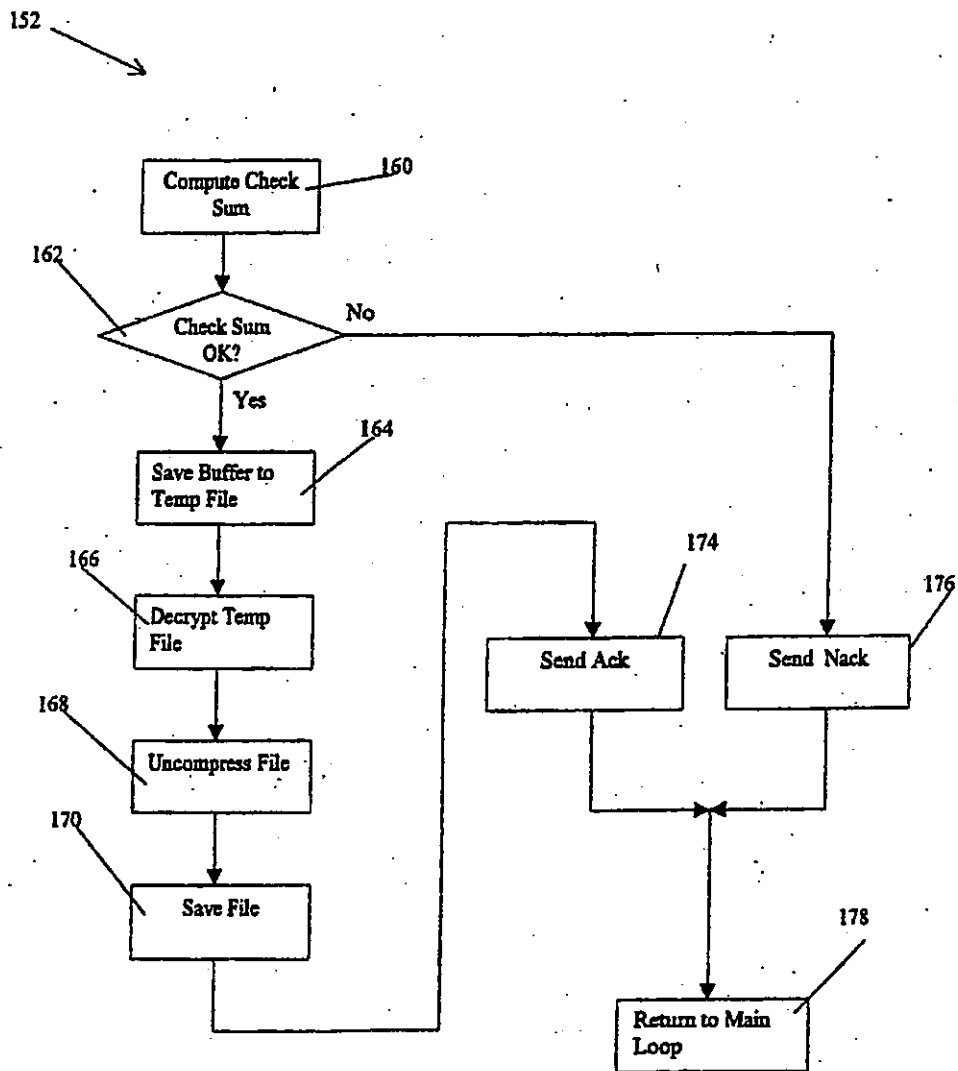
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FIGURE 7

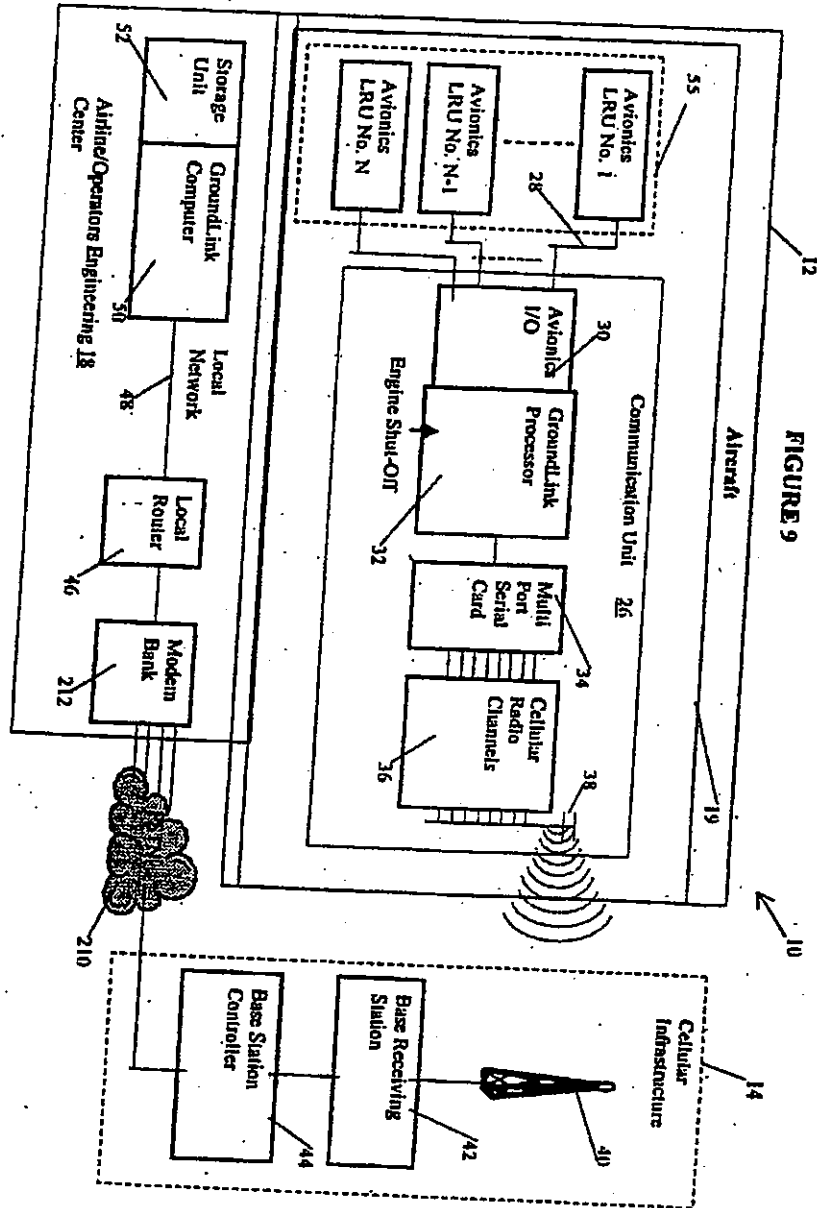


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FIGURE 8



9/9



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5 DESCRIPTION OF INVENTION

10 "IMPROVEMENTS IN OR RELATING TO AIRCRAFT AVIONICS
MAINTENANCE DIAGNOSTICS DATA DOWNLOAD
TRANSMISSION SYSTEM"

15 THE PRESENT INVENTION is directed generally to an aircraft maintenance/diagnostics data transmission system and, more particularly, to an on-board cellular data transmission/reception system operable in conjunction with maintenance/diagnostics data transmission over public telephone networks and the Internet.

20 It is common for aircraft avionics and electronic engine control systems to require download of maintenance/diagnostic data for maintenance purposes. Presently, most aircraft utilized in passenger, freighter and business categories require some degree of diagnostic data download from one or more avionics and engine control equipment, such as an Electronic Engine Computer (EEC), Data Encryption Unit (DEU), Flight Management Computer (FMC), etc.
25 These downloads are currently accomplished manually by connecting a download device to the aircraft, or using permanently installed maintenance/diagnostics terminals. The diagnostic information is transferred from the avionics equipment to storage media, such as floppy disks or CD-ROMs. Upon completion of the transfer from the avionics unit to the

storage media, the maintenance/diagnostic information is transferred to the maintenance centre of the airline for processing.

The current manual download includes the human as an active
5 component of this activity. The steps include the downloading to a media, delivery of the media to the maintenance facilities and transfer of the data from the media to a maintenance computer for analysis.

Computer systems are typically used to analyse and manage the aircraft
10 maintenance/diagnostics for the aircraft. Such systems require manual transportation of the down load media from each aircraft to the maintenance centre.

Often times, radio frequency (RF) transmissions are used to transmit
15 maintenance/diagnostic data relating to an aircraft. This technique, however, requires substantial investments to construct the RF transmission systems required for such a system to work. Furthermore, it is very expensive to create redundancy in such a system. Maintenance/diagnostic data can also be transmitted to an aircraft via a telephone system located in a terminal. Such a
20 system, however, requires that the aircraft be docked at the gate before transmission begins, thereby resulting in not being able to transfer uploads to aircraft that are routinely parked on the tarmac, away from the gates when loading and unloading passengers and cargo. Furthermore, such a system requires an added step of transmitting the download maintenance/diagnostic
25 data from the telephone system to the maintenance centre, increasing the cost of installing, operating, and maintaining such a system.

Thus, there is a need for an aircraft maintenance/diagnostics download system that automatically transfers aircraft/engine and maintenance/diagnostic

data to the airline's or operator's maintenance and engineering centre with little or no human involvement, and which relies on a widely available and reliable public wireless, public switch telephone network (PSTN), integrated services digital network (ISDN), and/or Internet delivery systems.

5

The present invention, which addresses this need, resides in a system, method and an article of manufacture for transmitting maintenance and diagnostic data from an aircraft.

10

According to one aspect of this invention there is provided an aircraft maintenance data transmission system, comprising:

an aircraft having an avionics system and a communications unit, wherein the avionics system comprises a plurality of line replaceable units, and wherein the communications unit is connected to each line replaceable;

15

a cellular infrastructure in communication with said communications unit after the aircraft has landed, wherein the communication is initiated automatically upon the landing of the aircraft; and
a data reception unit connected to the cellular infrastructure.

20

Preferably the line replaceable unit is an avionics line replaceable unit.

Conveniently the line replaceable unit is a an electronic engine control line replaceable unit.

25

Advantageously said data reception unit is in communication with said cellular infrastructure via a computer network.

Preferably the computer network is the Internet.

Conveniently said data reception unit is in communication with said cellular infrastructure via a telephone network.

5 Preferably the telephone network is a public switch telephone network.

Advantageously the telephone network is an integrated services digital telephone network.

10 Preferably said communications unit includes:
an avionics input/output interface;
a processor that is connected to the avionics input/output interface;
a multi-port serial card in communication with said processor;
a plurality of cell channels in communication with said multi-port serial
15 card; and
one or more antennas in communication with said cell channels.

Conveniently said cellular infrastructure includes:
an antenna;
20 a transceiver subsystem in communication with said antenna; and
a controller in communication with said transceiver subsystem.

Advantageously said data reception unit includes:
a router; and
25 a processor in communication with said router, said processor having a storage unit.

According to another aspect of this invention there is provided an aircraft maintenance data system, comprising:

5

an avionics system that comprises a plurality of line replaceable units;
an avionics input/output interface that is connected each of the line
replaceable units;

5 a processor that is connected to the avionics input/output interface;
a multi-port serial card that is connected to the processor; and
a plurality of cell channels connected to the multi port serial card, said
cell channels for transmitting data via a cellular infrastructure after the aircraft
has landed, wherein the communication between the cell channels and the multi
port serial card is automatically initiated upon the landing of the aircraft.

10

The system may further comprise one or more antennas in
communication with said cell channels.

Advantageously the processor is a personal computer.

15

Alternatively the processor is an application specific integrated circuit.

Alternatively the processor is a microprocessor.

20

The invention also relates to an aircraft, comprising:

an avionics system having a plurality of line replaceable units; and
a communications unit connected to each of the line replaceable units,
comprising:

25

an avionics input/output interface;
a processor connected to the avionics input/output interface;
a multi-port serial card connected to the processor; and
a plurality of cell channels connected to the multi port serial card, said
cell channels for transmitting data via a cellular infrastructure after the aircraft

6

has landed, wherein the communication between the cell channels and the multi port serial card is automatically initiated upon the landing of the aircraft.

The invention further relates to an aircraft data transmission system, the aircraft having an avionics system, comprising:

means for transmitting data from the avionics system via a cellular infrastructure after the aircraft has landed, wherein the transmission of the data is initiated automatically upon landing of the aircraft; and

means for receiving said data from said cellular infrastructure.

10

Conveniently said means for transmitting data includes a processor.

Preferably said means for receiving data includes a processor.

15 The invention also relates to a method of transmitting maintenance and diagnostic data from an aircraft, comprising:

at the aircraft;

receiving the maintenance and diagnostic data from a plurality line replaceable units;

20 transmitting the maintenance and diagnostic data via a cellular communications infrastructure after the aircraft has landed, wherein the cellular communications infrastructure is accessed automatically upon landing of the aircraft; and

at a data reception unit, receiving the transmitted maintenance and
25 diagnostic data.

In a further embodiment the invention relates to a method of transmitting maintenance and diagnostic data from an avionics system located on an aircraft, comprising:

7

receiving the maintenance and diagnostic data from a plurality of line replaceable units;

processing maintenance and diagnostic data; and
transmitting the processed maintenance and diagnostic data via a cellular
5 infrastructure after the aircraft has landed, wherein the cellular infrastructure is
accessed automatically upon landing of the aircraft.

The method may further comprise receiving said transmitted data at a flight operations centre.

10

Alternatively the method may further comprise receiving said transmitted data at a flight operations centre via a computer network.

Alternatively the method may further comprise receiving said
15 transmitted data at a flight operations centre via a telephone network.

Preferably processing said data includes:

compressing the data;

encrypting the data;

20 segmenting the data; and

constructing packets of data from said segmented data.

Conveniently receiving said transmitted data includes:

acknowledging receipt of said transmitted data;

25 reassembling said received data;

decrypting said reassembled data;

uncompressing said decrypted data; and

storing said uncompressed data.

The invention may be considered to relate to a method of transmitting maintenance and diagnostic data from an aircraft, comprising:

receiving data from a plurality of line replaceable units;

5 processing the data; and

transmitting the processed data via a cellular infrastructure after the aircraft has landed, wherein processing said data includes:

receiving a signal which indicates that the data transmission process can begin;

10 initiating a data transfer;

compressing said data;

encrypting said compressed data;

creating a packet queue;

starting a primary data thread;

15 waiting a predetermined period of time;

determining if any threads are active;

repeating, when threads are active, the steps of waiting a predetermined period of time and determining if any threads are active; and

exiting processing said data when no threads are active.

20

Preferably starting a primary data thread includes:

initiating a PPP connection;

initiating a transfer session;

starting at least one secondary data thread;

25 determining if data remains in the primary data thread;

sending said data when data remains in the primary data thread;

determining if data threads are active when no data remains in the primary data thread;

9

repeating, when said threads are active, the step of determining if data remains in the primary data thread;

ending said session when no threads are active;

closing said PPP connection; and

5 exiting starting a primary data thread.

Conveniently starting at least one secondary data thread includes:

(a) setting the secondary data thread to active;

(b) initiating a PPP connection;

10 (c) determining if data remains in the secondary data thread;

(d) sending a data packet when data remains;

(e) repeating step c when data remains;

(f) closing said PPP connection when no data remains;

(g) setting the secondary data thread to inactive;

15 (h) exiting starting at least one secondary data thread; and

(i) repeating steps a through h for each secondary data thread.

Advantageously repeating steps a through h includes repeating steps a through h in parallel for each said secondary data thread.

20

The invention also relates to a computer-implemented method of transmitting maintenance and diagnostic data from an aircraft, comprising:

receiving the maintenance and diagnostic data from a plurality of line replaceable units;

25 processing the maintenance and diagnostic data; and

transmitting the processed data via a cellular infrastructure after the aircraft has landed; and

receiving the transmitted data at a flight operations centre, wherein receiving said transmitted data includes:

10

creating a socket;
receiving a message;
determining if said message is an initialisation message;
initiating a session when said message is an initialisation message;
5 determining if said message is a data message when said message is not
an initialisation message;
processing said message when said message is a data message;
determining if said message is an end session when said message is not a
data message;
10 processing said message when said message is an end session; and
repeating, when said message is not an end session message, the step of
receiving a message.

Preferably initiating a session includes:
15 allocating buffer space;
sending an initiation session acknowledgement; and
returning to receiving a message.

Advantageously processing said message when said message is a data
20 message includes:
copying said message to a buffer;
sending a data message acknowledgement; and
returning to receiving a message.

25 Preferably processing said message when said message is not an end
session includes:
computing a checksum;
determining if said checksum is valid;

11

saving a buffer to a temporary file;
decrypting said temporary file;
uncompressing said temporary file;
sending an end session acknowledgement; and
5 returning to receiving a message.

The invention also relates to an article of manufacture comprising a computer program carrier, readable by a processor and embodying one or more instructions executable by the processor to perform the method of transmitting
10 maintenance and diagnostic data from an avionics system located on an aircraft, the method comprising:

receiving maintenance and diagnostic data from a plurality of line replaceable units;

processing said maintenance and diagnostic data to prepare said data for
15 transmission; and

transmitting said processed data via a cellular infrastructure when said aircraft has landed, wherein the cellular infrastructure is accessed automatically upon landing of the aircraft.

20 The system comprises an aircraft, a cellular infrastructures and a data reception unit. The aircraft has an avionics system and a communications unit. The avionics system comprises a plurality of line replaceable units. The communications unit is connected to each line replaceable unit. The cellular infrastructure is in communication with said communications unit after the
25 aircraft has landed. The communication is initiated automatically upon the landing of the aircraft. The data reception unit is connected to the cellular infrastructure.

The preferred embodiment of the present invention represents a substantial advance over prior aircraft data download systems. For example, the present invention has the advantage that it requires little expense to implement because it uses well-known cellular technology, cellular
5 infrastructure, telephone networks and computer networks, which are already in place. The preferred embodiment of the present invention also has the advantage that it can transmit the diagnostic data over one or more channels to achieve the necessary transmission bandwidth and achieve a low data transmission time. The preferred embodiment of the present invention has the
10 further advantage that it does not require a dedicated data link between the aircraft and the airline/aircraft operator engineering centre and/or an airport terminal.

For the present invention to be clearly understood and readily practised,
15 the present invention will be described in conjunction with the following figures, in which like reference numbers represent corresponding parts throughout:

FIGURE 1 illustrates an exemplary aircraft maintenance data download
20 and transmission system, in accordance with an embodiment of the present invention;

FIGURE 2 is a block diagram illustrating a more detailed embodiment of
the system illustrated in FIGURE 1, in accordance with an embodiment of the
25 present invention;

FIGURE 3 is a block diagram illustrating data flow through the system
illustrated in FIGURE 2, in accordance with an embodiment of the present
invention;

FIGURE 4 is a flowchart illustrating a method carried out by the GroundLink processor in the aircraft, in accordance with an embodiment of the present invention;

5

FIGURE 5 is a flowchart illustrating a method of performing the start secondary data threads and transmitting data packet step 89 of FIGURE 4, in accordance with an embodiment of the present invention;

10

FIGURE 6 is a flowchart illustrating a method of performing the start secondary data threads step 103 of FIGURE 5, in accordance with an embodiment of the present invention;

15

FIGURE 7 is a flowchart illustrating a method of operating the GroundLink computer in the airlines/operators engineering centre, in accordance with an embodiment of the present invention;

20

FIGURE 8 is a flowchart illustrating a method of performing the process end of session step 152 of FIGURE 7, in accordance with an embodiment of the present invention;

FIGURE 9 is a block diagram illustrating another embodiment of the system illustrated in FIGURE 1.

25

In the following description, reference is made to the accompanying drawings which form a part hereof, and which is shown only by way of illustration a specific embodiment in which the invention may be practised. It is to be understood that other embodiments may be utilized and changes may be made without departing from scope of the present invention.

It is to be understood that the figures and descriptions of the present invention have been simplified to illustrate elements that are relevant for a clear understanding of the present invention, while eliminating, for purposes of clarity, other elements found in a typical communications system. It can be recognised that other elements are desirable and/or required to implement a device incorporating the present invention. For example, the details of the avionics and engine maintenance data download method, the cellular communications infrastructure, the Internet, and the public-switched telephone network are not disclosed. However, because such elements are well known in the art, and because they do not facilitate a better understanding of the present invention, a discussion of such elements is not provided herein.

FIGURE 1 illustrates an exemplary aircraft transmission/reception of avionics and engine maintenance/diagnostic data download system 10, in accordance with an embodiment of the present invention. An aircraft 12, which has stored avionics and electronic engine control units maintenance/diagnostics data, is illustrated after landing. The aircraft 12 transmits maintenance/diagnostics data as cellular communications signals over a cellular infrastructure 14. The cellular infrastructure 14 acts as a communications channel to the communications medium 16. Airline/operators engineering centre 18 is connected to the medium 16 by any conventional connectivity medium such as, for example, a leased line. Once the cellular connections are made via the medium 16 data can flow bidirectionally to and from the aircraft.

FIGURE 2 is a block diagram illustrating a more detailed embodiment of system 10 illustrated in FIGURE 1, in accordance with an embodiment of the present invention. The aircraft 12 includes avionics system 55 having a suite (1 through N) of avionics (and electronic engine control) line replaceable units

(LRU). Each avionics and electronic engine control line replaceable unit includes a storage media for storing maintenance/diagnostics data in a digital format.

5 The maintenance/diagnostics data are transferred from the avionics and electronic engine control unit LRU 55 to the communications unit 26 via a bus 28. The bus 28 is connected to an avionics I/O interface 30 in the communications unit 26. The avionics I/O interface 30 can be a standard bus interface such as, for example, an ARINC 429 bus, RS-232/422 or Ethernet.

10

 The avionics I/O interface 30 is connected to a GroundLink processor 32. The GroundLink processor 32 can be a general purpose processor such as a personal computer, a microprocessor such as an Intel Pentium.RTM processor, or a special purpose processor such as an application specific integrated circuit
15 (ASIC) designed to operate in the system 10. The GroundLink processor is connected to one or more cellular channels 36 via multi port serial card 34.

 The GroundLink processor 32 is responsive to an engine shut-off (or equivalent) signal, which notifies the GroundLink processor 32 to initiate
20 transmission of the data after the aircraft 12 has landed. Upon receipt of this signal, the processor 32 acquires the maintenance/diagnostic data from the avionics LRU 55 via the avionics I/O 30, and transmits the data to a multi-port serial card 34. Each I/O port of the card 34 is attached to a cellular channel 36 which can open, sustain, and close a physical, over-the-air, channel to the
25 cellular infrastructure 14. The cellular channels 36 can transmit and receive simultaneously and can thus transmit and receive data in parallel. Each cellular channel 36 is connected to an antenna matching network. One or more antennas 38 are installed in the aircraft 12 so as to optimise free space radiation to the cellular infrastructure 14.

The data are transmitted over cellular air link using the physical layer modulation of the cellular infrastructure 14. The cellular infrastructure 14 includes an antenna 40, which is within free-space radiating range of the aircraft 12. The antenna 40 is connected to a cellular base station transceiver subsystem 42. The subsystem 42 is connected to a cellular base station controller 44 which has a direct connection via a router (not shown) to the Internet 45. The data is transmitted via the Internet 45 to the airline/operators engineering centre 18.

10

A local router 46 in the airline/operators engineering centre 18 is connected to the Internet 45, such as via a connection to the backbone of the Internet 45. The router 46 connects a local area network 48 to the Internet 45. The local area network can be of any type of network such as, for example, a token ring network, an ATM network, or an Ethernet network. A GroundLink computer 50 is connected to the network 48 and receives the maintenance/diagnostics data from the specific aircraft tail number for storage in the attached storage unit 52 for analysis by related application programs. The storage unit 52 can be any type of unit capable of storing data such as, for example; disk drive or a disk array.

15

20

Data transfer can also occur from airline/operators engineering centre 18 to the aircraft 12. The data are transmitted over the Internet 45 and cellular infrastructure 14 and received by antenna 38. The serial card 34 receives the data from the cellular channels 38 and processor 32 outputs the data via the avionics I/O 30 to avionics 55 via bus 28.

25

FIGURE 3 is a block diagram illustrating data flow through the system 10 illustrated in FIGURE 2, in accordance with an embodiment of the present

invention. The maintenance data files are stored by the avionics LRUs. An application layer 58 of an operating system 60 of the GroundLink processor 32 acquires, compresses, encrypts, and segments the data files. The operating system 60 can be any type of operating system suitable such as, for example, UNIX. A typical stored file may be compressed from approximately 1 Mbytes to approximately 100 Kbytes. Compression may be done by any compression method such as, for example, the method embodied in the PKZIP.RTM. compression utility, manufactured by PKWARE, Inc. Encryption can be accomplished using any suitable asymmetric (public key) or symmetric encryption method such as, for example, the method embodied in Data Encryption Software (DES), manufactured by American Software Engineering or the methods in the RC2, RC4, or RC5 encryption software manufactured by RSA Data Security, Inc. During segmentation, individual datagrams of, for example, 1024 bytes are formed and indexed for subsequent reassemble.

15

The operating system 60 passes the datagrams to a network layer 62 which constructs UDP/IP packets from the datagrams by adding message headers to the datagrams. The network layer 62 then routes the packets to one of up to a fixed number (e.g., 16) peer-to-peer protocol (PPP) threads running within the operating system 60 at a data link layer interface 64. The PPP convey the packets through the multi port serial card 34 to the cellular channels 36. The packets are routed through the cellular infrastructure 14 to the Internet 45. The packets are received from the Internet 45 by the local router 46 in the airline/operators engineering centre 18. The network layer 62 receives acknowledgements of received packets from the GroundLink computer 50 in the airline/operators engineering centre 18. The network layer 62 also re-queues packets that are dropped before reaching the GroundLink computer 50.

25

The local router 46 in the airline/operators engineering centre 18 receives the packets and routes them to the GroundLink computer 50. A local network interface 68 receives the packets and a data link layer interface 70 of an operating system 72 passes the packets to a network layer 74 of the operating system 72. The operating system 72 can be any type of suitable operating system such as, for example Windows. The network layer 74 sends acknowledgements of successful packet deliveries to the GroundLink processor 32. The network layer 74 also removes the UPD/IP headers and passes the datagrams to an application layer 76. The application layer 76 reassembles, decrypts, and uncompresses the datagrams to restore the file to its original form. The application layer then passes the file 78 to the storage unit 52. The functions performed by the aircraft 12 and the airline/operator engineering centre 18 are similarly interchangeable when data is transferred from the airline/operator engineering centre 18 to the aircraft 12.

FIGURE 4 is a flowchart illustrating a method carried out by the GroundLink processor 32 in the aircraft, in accordance with an embodiment of the present invention. At step 81, the GroundLink processor 32 receives a "engine shut-off", or similar signal which indicates that data transmission process can be started and the GroundLink processor 32 initiates a data transfer by acquiring maintenance/diagnostics data files from avionics LRUs 55. At step 83, the application layer 58 compresses the acquired files and at step 84 it encrypts the file. At 86 the data is segmented into datagrams and UPD/IP packets are created and the packets are placed in a queue. The packets are ready for transmission over fixed number of threads, corresponding to the number of cellular channels 36. At step 89, the primary data thread is started to make the initial call and open the communications channel to the airline/operators engineering centre 18. There is a wait period, for example five seconds, inserted at step 91, and the status of the threads is tested for active

state at step 92. If any thread is found active the process loops back to the wait state. If there are no active channels detected at step 92 this method exits at step 93.

5 FIGURE 5 is a flowchart illustrating a method of performing the start primary data thread step 89 of FIGURE 4, in accordance with an embodiment of the present invention. At step 100 point to point (PPP) connection is initiated. At step 102 the process session is initiated. The secondary data threads are opened at step 103.

10 At step 104, it is determined if more packets are left to be transmitted. If so, the next packet in the data thread is transmitted at step 106 and the process loops back to step 104 to check if any more packet is available for transmission. If no packets are left to transmit, as determined at step 104, the state of the data
15 threads is checked at step 108. If any data thread is found active at 108, then the process returns to step 104 to see if more data is to be transmitted. If it is found at step 108 that there is no active data thread then the session is ended at step 110. The PPP connections are closed at step 112 and the method exits at step 114.

20 FIGURE 6 is a flowchart illustrating a method of starting secondary data threads of step 103 of FIGURE 5, in accordance with an embodiment of the present invention. All the available secondary data threads are set active in step 118 by the data link interface 64. At step 120 the point to point (PPP)
25 connections are initiated for each secondary data thread through the cellular channels 36 by the data link layer 64. At step 122 a test is made to determine if there are data packets for transmission. If packet is available, it is sent in step 124 to the GroundLink computer. If there is no more data packets to be sent, as

determined in step 122, the PPP connections are closed in step 126. The thread is set inactive in step 128 and the thread exits at step 130.

FIGURE 7 is a flowchart illustrating a method of operating the GroundLink computer 50 in the airline/operators engineering centre 18, in accordance with an embodiment of the present invention. In response to the call placed by the GroundLink processor 32 through the primary channel a socket is opened at step 132 by the operating system 72 in the computer 50 to receive messages transported across the Internet 45. At step 134, the computer 50 waits for a message from the Internet 45. When an initiate session message is received as determined at step 136, the application layer 76 allocates buffer space at step 138, sends a session acknowledgement message at step 140 to the GroundLink processor 32 on the aircraft 12 and the method returns to wait for additional messages at step 134. If the message received was a data packet, as determined at step 142, the network layer 74 removes the UDP/IP header and copies the datagram to the buffer in step 144. At step 146 the network layer 74 sends an acknowledge message to the GroundLink processor 32 on the aircraft 12.

If end session message is detected at step 148 the application layer 76 performs a process end session at step 152 and returns to wait for message step 134.

FIGURE 8 is a flowchart illustrating the steps included in the end session process step 152 of FIGURE 7, in accordance with an embodiment of the present invention. At step 160, the checksum is computed by the application layer 76 for the received data to check the integrity of the data. The checksum is checked at step 162 and if it is found to be correct the GroundLink computer 50 saves the buffer to a temporary file at step 164. The application

layer 76 of the GroundLink computer 50 then decrypts the file at step 166 and uncompresses the file at step 168. The uncompressed file 78 is stored at step 170 by the operating system 72 on storage unit 52. The GroundLink computer 50 sends an end session acknowledge message to the GroundLink processor 32 on aircraft 12 at step 174 and at step 178 the flow returns to step 134 of FIGURE 7. If the checksum is not correct, as determined at step 162, the GroundLink computer 50 sends an unsuccessful end session message (Nack) at step 176, which notifies the GroundLink processor 32 to re-send the data and the flow returns to step 134 of FIGURE 7.

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FIGURE 9 is a block diagram illustrating another embodiment of the system 10 illustrated in FIGURE 1. The operation of the system 10 of FIGURE 9 is similar to that described in conjunction with the system 10 of FIGURE 2. However, the data that is transmitted by the GroundLink processor 32 via the cellular infrastructure 14 is routed by the public switched telephone network (PSTN) 210 to the modem bank 212. A modem bank 212 transmits the data to the GroundLink computer 50 via the local router 46 and local network 48. The modem bank 212 can have a modem dedicated to receive data from each one of the cellular channels 36.

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While the present invention has been described in conjunction with preferred embodiments thereof, many modifications and variations will be apparent to those of ordinary skill in the art. For example, although the system has been described hereinabove as transferring data from the aircraft, the system can also be used to transfer data to the aircraft with no modifications in the system. Also, the system may be used to transmit data while the aircraft is in flight. Furthermore, the system may be used without encryption and without data compression prior to sending data. The foregoing description and the following claims are intended to cover all such modifications and variations.

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In the present Specification "comprises" means "includes or consists of" and "comprising" means "including or consisting of".

5 The features disclosed in the foregoing description, or the following Claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse
10 forms thereof.

CLAIMS

- 5 1. An aircraft maintenance data transmission system, comprising:
an aircraft having an avionics system and a communications unit,
wherein the avionics system comprises a plurality of line replaceable units, and
wherein the communications unit is connected to each line replaceable;
a cellular infrastructure in communication with said communications
10 unit after the aircraft has landed, wherein the communication is initiated
automatically upon the landing of the aircraft; and
a data reception unit connected to the cellular infrastructure.
2. The aircraft maintenance data transmission system of claim 1, wherein
15 the line replaceable unit is an avionics line replaceable unit.
3. The aircraft maintenance data transmission system of claim 1, wherein
the line replaceable unit is a an electronic engine control line replaceable unit.
- 20 4. The aircraft maintenance data transmission system of claim 1, 2 or 3,
wherein said data reception unit is in communication with said cellular
infrastructure via a computer network.
5. The aircraft maintenance data transmission system of claim 4, wherein
25 the computer network is the Internet.
6. The aircraft maintenance data transmission system of claim 1, 2 or 3,
wherein said data reception unit is in communication with said cellular
infrastructure via a telephone network.

7. The aircraft maintenance data transmission system of claim 6, wherein the telephone network is a public switch telephone network.
- 5 8. The aircraft maintenance data transmission system of claim 6, wherein the telephone network is an integrated services digital telephone network.
9. The aircraft maintenance data transmission system of any one of claims 1 to 8, wherein said communications unit includes:
 - 10 an avionics input/output interface;
 - a processor that is connected to the avionics input/output interface;
 - a multi-port serial card in communication with said processor;
 - a plurality of cell channels in communication with said multi-port serial card; and
 - 15 one or more antennas in communication with said cell channels.
10. The aircraft maintenance data transmission system of any one of claims 1 to 9, wherein said cellular infrastructure includes:
 - an antenna;
 - 20 a transceiver subsystem in communication with said antenna; and
 - a controller in communication with said transceiver subsystem.
11. The aircraft maintenance data transmission system of any one of the preceding claims, wherein said data reception unit includes:
 - 25 a router; and
 - a processor in communication with said router, said processor having a storage unit.
12. An aircraft maintenance data system, comprising:

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an avionics system that comprises a plurality of line replaceable units;
an avionics input/output interface that is connected each of the line
replaceable units;

a processor that is connected to the avionics input/output interface;

5 a multi-port serial card that is connected to the processor; and

a plurality of cell channels connected to the multi port serial card, said
cell channels for transmitting data via a cellular infrastructure after the aircraft
has landed, wherein the communication between the cell channels and the multi
port serial card is automatically initiated upon the landing of the aircraft.

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13. The aircraft maintenance data system of claim 12, further comprising
one or more antennas in communication with said cell channels.

14. The aircraft maintenance data system of claim 12 or 13, wherein the
15 processor is a personal computer.

15. The aircraft maintenance data system of claim 12 or 13, wherein the
processor is an application specific integrated circuit.

20 16. The aircraft maintenance data system of claim 12 or 13, wherein the
processor is a microprocessor.

17. An aircraft, comprising:

an avionics system having a plurality of line replaceable units; and

25 a communications unit connected to each of the line replaceable units,
comprising:

an avionics input/output interface;

a processor connected to the avionics input/output interface;

a multi-port serial card connected to the processor; and
a plurality of cell channels connected to the multi port serial card, said
cell channels for transmitting data via a cellular infrastructure after the aircraft
has landed, wherein the communication between the cell channels and the multi
5 port serial card is automatically initiated upon the landing of the aircraft.

18. An aircraft data transmission system, the aircraft having an avionics
system, comprising:

means for transmitting data from the avionics system via a cellular
10 infrastructure after the aircraft has landed, wherein the transmission of the data
is initiated automatically upon landing of the aircraft; and

means for receiving said data from said cellular infrastructure.

19. The aircraft data transmission system of claim 18, wherein said means
15 for transmitting data includes a processor.

20. The aircraft data transmission system of claim 18 or 19, wherein said
means for receiving data includes a processor.

20 21. A method of transmitting maintenance and diagnostic data from an
aircraft, comprising:

at the aircraft;

receiving the maintenance and diagnostic data from a plurality line
replaceable units;

25 transmitting the maintenance and diagnostic data via a cellular
communications infrastructure after the aircraft has landed, wherein the cellular
communications infrastructure is accessed automatically upon landing of the
aircraft; and

at a data reception unit, receiving the transmitted maintenance and diagnostic data.

22. A method of transmitting maintenance and diagnostic data from an avionics system located on an aircraft, comprising:

receiving the maintenance and diagnostic data from a plurality of line replaceable units;

processing maintenance and diagnostic data; and

transmitting the processed maintenance and diagnostic data via a cellular infrastructure after the aircraft has landed, wherein the cellular infrastructure is accessed automatically upon landing of the aircraft.

23. The method of claim 22, further comprising receiving said transmitted data at a flight operations centre.

24. The method of claim 22, further comprising receiving said transmitted data at a flight operations centre via a computer network.

25. The method of claim 22, further comprising receiving said transmitted data at a flight operations centre via a telephone network.

26. The method of any one of claims 19 to 26, wherein processing said data includes:

compressing the data;

encrypting the data;

segmenting the data; and

constructing packets of data from said segmented data.

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27. The method of claim 22 or any claims dependent thereon, wherein receiving said transmitted data includes:

acknowledging receipt of said transmitted data;

reassembling said received data;

5 decrypting said reassembled data;

uncompressing said decrypted data; and

storing said uncompressed data.

28. A method of transmitting maintenance and diagnostic data from an aircraft, comprising:

10 receiving data from a plurality of line replaceable units;

processing the data; and

transmitting the processed data via a cellular infrastructure after the aircraft has landed, wherein processing said data includes:

15 receiving a signal which indicates that the data transmission process can begin;

initiating a data transfer;

compressing said data;

encrypting said compressed data;

20 creating a packet queue;

starting a primary data thread;

waiting a predetermined period of time;

determining if any threads are active;

25 repeating, when threads are active, the steps of waiting a predetermined period of time and determining if any threads are active; and

exiting processing said data when no threads are active.

29. The method of claim 28 wherein starting a primary data thread includes:

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- initiating a PPP connection;
- initiating a transfer session;
- starting at least one secondary data thread;
- determining if data remains in the primary data thread;
- 5 sending said data when data remains in the primary data thread;
- determining if data threads are active when no data remains in the primary data thread;
- repeating, when said threads are active, the step of determining if data remains in the primary data thread;
- 10 ending said session when no threads are active;
- closing said PPP connection; and
- exiting starting a primary data thread.

30. The method of claim 29 wherein starting at least one secondary data thread includes:

- (a) setting the secondary data thread to active;
- (b) initiating a PPP connection;
- (c) determining if data remains in the secondary data thread;
- (d) sending a data packet when data remains;
- 20 (e) repeating step c when data remains;
- (f) closing said PPP connection when no data remains;
- (g) setting the secondary data thread to inactive;
- (h) exiting starting at least one secondary data thread; and
- (i) repeating steps a through h for each secondary data thread.

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31. The method of claim 30, wherein repeating steps a through h includes repeating steps a through h in parallel for each said secondary data thread.

32. A computer-implemented method of transmitting maintenance and diagnostic data from an aircraft, comprising:

receiving the maintenance and diagnostic data from a plurality of line replaceable units;

5 processing the maintenance and diagnostic data; and

transmitting the processed data via a cellular infrastructure after the aircraft

has landed; and

receiving the transmitted data at a flight operations centre, wherein

10 receiving said transmitted data includes:

creating a socket;

receiving a message;

determining if said message is an initialisation message;

initiating a session when said message is an initialisation message;

15 determining if said message is a data message when said message is not an initialisation message;

processing said message when said message is a data message;

determining if said message is an end session when said message is not a data message;

20 processing said message when said message is an end session; and repeating, when said message is not an end session message, the step of receiving a message.

33. The method of claim 32 wherein initiating a session includes:

25 allocating buffer space;

sending an initiation session acknowledgement; and

returning to receiving a message.

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34. The method of claim 32 or 33, wherein processing said message when said message is a data message includes:

copying said message to a buffer;
sending a data message acknowledgement; and
5 returning to receiving a message.

35. The method of claim 32, wherein processing said message when said message is not an end session includes:

10 computing a checksum;
determining if said checksum is valid;
saving a buffer to a temporary file;
decrypting said temporary file;
uncompressing said temporary file;
sending an end session acknowledgement; and
15 returning to receiving a message.

36. An article of manufacture comprising a computer program carrier, readable by a processor and embodying one or more instructions executable by the processor to perform the method of transmitting maintenance and diagnostic data from an avionics system located on an aircraft, the method comprising:

20 receiving maintenance and diagnostic data from a plurality of line replaceable units;
processing said maintenance and diagnostic data to prepare said data for transmission; and
25 transmitting said processed data via a cellular infrastructure when said aircraft has landed, wherein the cellular infrastructure is accessed automatically upon landing of the aircraft.

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37. An aircraft maintenance data transmission system substantially as herein described with reference to and as shown in the accompanying drawings.

39. A method of transmitting maintenance and diagnostic data substantially as herein described with reference to and as shown in the accompanying drawings.

39. An aircraft substantially as herein described with reference to and as shown in the accompanying drawings.

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40. An article of manufacture comprising a computer programme substantially as herein described with reference to and as shown in the accompanying drawings.

15 41. Any novel feature or combination of features disclosed herein.



Application No: GB 0323990.2
Claims searched: All

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Examiner: Steve Evans
Date of search: 19 March 2004

Patents Act 1977 : Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance	
X	1, 12, 17, 18, 21, 22, 28, 32 & 36 at least	US 6181990 B1	(TELEDYNE) - Whole document
Y	1, 12, 17, 18, 21, 22, 28, 32 & 36 at least	US 6308045 B1	(HARRIS) - Whole document
Y	As above	US 6108523 A	(HARRIS) - Whole document
Y	As above	US 5974349 A	(LEVINE) - Whole document
Y	As above	GB 2345824 A	(MINORPLANET) - Whole document
A		EP 1280316 A3	(Aircraft Management Holdings) - Whole document

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^W:

H4L

Worldwide search of patent documents classified in the following areas of the IPC⁷:

G06F; H04L

The following online and other databases have been used in the preparation of this search report:

EPODOC, JAPIO, WPI